DOCUMENT RESUME

ED 314 624 CE 053 983

TITLE	Trade and Technical. Volume II. Access Skills. Vocational Readiness Skills. Missouri LINC. Assessing Vocational Education.
INSTITUTION	Missouri Univ., Columbia. Dept. of Practical Arts and Vocational-Technical Education.; Missouri Univ., Columbia. Dept. of Special Education.
SPONS AGENCY	Missouri State Dept. of Elementary and Secondary Education, Jefferson City.
PUB DATE	Nov 88
NOTE	410p.; For related documents, see CE 053 979-990.
AVAILABLE FROM	Instructional Materials Laboratory, 10 London Hall, University of Missouri-Columbia, Columbia, MO 65211 ($22.00).
PUB TYPE	Guides - Classroom Use - Guides (For Teachers) (052)
EDRS PRICE	MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS	*Access to Education; Agricultural Engineering; Auto Body Repairers; Auto Mechanics; Communication Skills; Competency Based Education; *Educational Diagnosis; Educational Objectives; Employment Potential; Interpersonal Competence; Machinists; Maintenance; Mathematics Skills; *Occupational Information; Power Technology; Secondary Education; Small Engine Mechanics; *Special Needs Students; *Trade and Industrial Education; Vocational Aptitude; Vocational Education; Vocational Evaluation; Vocational Maturity; Welding
IDENTIFIERS	*Missouri

ABSTRACT

This document contains trade and industrial occupations-related materials to help teachers and parents teach access skills to Missouri junior high and high school special needs students who want to pursue a vocational program in auto body repair, auto mechanics, building maintenance and custodial work, diesel mechanics, machinist, small engine repair and agricultural power and machinery, or welding. Access skills are defined as those skills needed to access vocational education programs and be successful in the world of work. An introduction explains this document's relationship to other documents about Missouri vocational education and describes the document's contents. The next seven sections contain competency lists, skills checklists on which teachers can record student competency, and instructional activities relevant to the seven vocations. The activities cover each of the five major areas (math, physical demands and working environment, aptitudes, temperament, and vocational) of Missouri's Vocational Readiness Inventory. Glossaries, tool lists, teacher and student worksheets, and lists of resources are included. The document concludes with nine instructional modules that teach basic safety and first aid; occupational vocabulary,; identification and use of tools; identification of automobile parts; basic operations using decimals and percents; basic operations using fractions; demanding physical movements; driver's test preparation; and how to read scales, dials, and gauges. The modules include task analysis sheets and directions for instruction. (CML)

CE

ED314624

CE053983

95-3277-I

Access Skills
Vocational Readiness Skills for Trade and Technical

EMPLOYMENT
AND
INDEPENDENCE

Accessing Vocational Education

Volume II

U.S. DEPARTMENT OF EDUCATION
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ACCESS SKILLS

Vocational Readiness Skills for
Trade and Technical II

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The project which is the subject of this handbook was supported in whole by funds from the Missouri Department of Elementary and Secondary Education. However, the opinions expressed herein do not necessarily reflect the position or policies of the Missouri Department of Elementary and Secondary Education and no official endorsement should be inferred.

November, 1988

This Book is Available From:
Instructional Materials Laboratory
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University of Missouri-Columbia
Columbia, MO 65211

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1-800-392-7217

ACKNOWLEDGEMENTS

Missouri LINC would like to express appreciation to all vocational education and special education instructors who have helped create the ACCESS SKILLS: Vocational Readiness Skills manuals. Ideas for activities came from many people who, as practitioners in the field, have first-hand knowledge of effective methods which meet the needs of students. Their dedication to special needs students provides valuable assistance to Missouri LINC staff in the development of resources and materials which enable students to become the best they can be.

A special thanks to our contributing authors who gave us some of the activities found in the manual:

Mary Alexander, Reading Specialist, College of Education, Florida State University, Tallahassee, Florida;

Phyllis Cole, VRE, Hillyard Area Vocational Technical School, St. Joseph, Missouri;

Donna Kearns, Instructor, Missouri LINC, Columbia, Missouri;

And to those who wrote modules for the original Entry Level Skills manual: Kathy Hartman, Carol Gillis, Jill Hastings, Lynn Barnett, Marilyn Lyles, Ann Wall, Carol French, Mary Hughes, Bernard Rothrock, and JoAnn Thomas.

We are grateful to LINC staff members,

Jan Wheeler, Graduate Research Assistant, and

David Gray, Instructor,

for their proofreading and editing comments, as well as to our typist, who also helped in editing,

Victoria Bowlin, Senior Clerk Typist.

TABLE OF CONTENTS

Introduction. 1

Manual Components 3

Autobody Repair 7
  VIMS Compentencies for Autobody Repair. 8
  ACCESS SKILLS Checklist for Autobody Repair 12
  Autobody Repair Vocabulary List 15
  Tool List for Autobody Repair 20
  Math. 21
  Physical Demands/Working Environment. 28
  Aptitudes 30
  Temperament 31
  Vocational. 33
  Resources 38

Automobile Mechanics. 39
  VIMS Competencies for Auto Mechanics. 40
  ACCESS SKILLS Checklist for Auto Mechanics. 43
  Auto Mechanics Vocabulary List. 46
  Tool List for Auto Mechanics 47
  Math. 48
  Physical Demands/Working Environment. 62
  Aptitudes 64
  Temperament 68
  Vocational. 69
  Resources 71

Building Maintenance/Custodial. 73
  ACCESS SKILLS Checklist for Building Maintenance/Custodial. . . . 74
  Building Maintenance/Custodial Vocabulary List. 76
  Tool List for Building Maintenance/Custodial. 77
  Math. 78
  Physical Demands/Working Environment. 81
  Aptitudes 83
  Temperament 84
  Vocational. 85
  Resources 86

Diesel Mechanics 87
  VIMS Competencies for Diesel Mechanics. 88
  ACCESS SKILLS Checklist for Diesel Mechanics. 92
  Diesel Mechanics Vocabulary List. 94
  Tool List for Diesel Mechanics. 99
  Math. 100
  Physical Demands/Working Environment. 104
  Aptitudes 106
  Temperament 111
  Vocational. 112
  Resources 115

Machinist 116
- VIMS Competencies for Machinist 117
- ACCESS SKILLS Checklist for Machinist 120
- Machinist Vocabulary List 122
- Tool List for Machinist 124
- Math. 125
- Physical Demands/Working Environment. 132
- Aptitudes 134
- Temperament 135
- Vocational. 140
- Resources 144

Small Engine Repair 147
- VIMS Competencies for Small Engine Repair 148
- ACCESS SKILLS Checklist for Small Engine Repair 149
- Small Engine Repair Vocabulary List 151
- Tool List for Small Engine Repair 152
- Math. 153
- Physical Demands/Working Environment. 157
- Aptitudes 159
- Temperament 167
- Vocational. 170
- Resources 171

Welding 173
- VIMS Competencies for Welding 174
- ACCESS SKILLS Checklist for Welding 178
- Welding Vocabulary List 180
- Tool List for Small Engine Repair 183
- Math. 184
- Physical Demands/Working Environment. 190
- Aptitudes 193
- Temperament 194
- Vocational. 196
- Resources 200

Instructional Modules 201
- Basic Safety and First Aid. 201
- Become Familiar with Vocabulary 215
- Identification and Use of Tools 232
- Identify Basic Parts of the Automobile. 260
- Perform Basic Operations Using Decimals and Percents. 299
- Perform Basic Operations Using Fractions. 309
- Physical Demands Movements. 338
- Prepare for Driver's License Test 345
- Read Scales, Dials and Gauges 397

INTRODUCTION

Since 1981, Missouri educators have been utilizing the Entry Level Skills Criteria (ELSC) Manual to help prepare special needs students for entry into and successful completion of vocational training programs. With the passage of the Carl D. Perkins Vocational Education Act (P.L. 98-524), the Missouri mandate for instructional management systems and competency-based education, there was a need to revise the ELSC Manual. These revisions make the materials more compatible with the recent educational changes and better meet the needs of practitioners in the field. ACCESS SKILLS is the new name for the ELSC.

ACCESS SKILLS: Vocational Readiness Skills are defined as those skills which appear to be correlated to success in vocational education programs. If a student acquires as many of these skills as possible, the chances of success are higher for the chosen vocational program. The ACCESS SKILLS: Vocational Readiness Skills are negotiable skills; that is, students who are deficient in one or more areas may still enter vocational programs. Through assessment, these weak areas will be determined and vocational instructors and support personnel can then continue to work on the skills during vocational training. There has been a great deal of confusion with the original term "entry level skills". This terminology in vocational education usually refers to the skills needed to enter the world of work. ACCESS SKILLS better explains the objective: to identify, assess and teach skills needed to access vocational education programs and be successful in the world of work.

The ACCESS SKILLS are available in several manuals:

ACCESS SKILLS: Vocational Readiness Skills Inventory for Special Needs Students (Revised Entry Level Skills Inventory)

ACCESS SKILLS have been identified for vocational programs listed on the Vocational Administrative Management System (VAMS). Skill areas include math, physical demands/working environment, aptitudes, temperament and vocational. Sample occupational areas, Classification of Industrial Programs (CIP) codes, and Dictionary of Occupational Titles (DOT) codes have been included as well as employability and study skills. The ACCESS SKILLS lists will also be included on VAMS.

ACCESS SKILLS: Employability and Study Skills Assessment and Curriculum Guide

This guide includes informal assessment instruments to evaluate thirty-five employability and study skills with instructional activities included to teach each skill. This guide was designed for junior high students, but is applicable to any secondary student with needs in these areas.

ACCESS SKILLS: Generic Informal Assessment Instruments and Checklist

This manual contains informal assessment instruments for each of the ACCESS SKILLS: Vocational Readiness Inventory and a checklist for documenting the assessment.

ACCESS SKILLS: Vocational Readiness Series

ACCESS SKILLS: Vocational Readiness Skills for Agriculture

ACCESS SKILLS: Vocational Readiness Skills for Business & Office

ACCESS SKILLS: Vocational Readiness Skills for Marketing & Cooperative Education

ACCESS SKILLS: Vocational Readiness Skills for Health Occupations

ACCESS SKILLS: Vocational Readiness Skills for Occupational Home Economics

ACCESS SKILLS: Vocational Readiness Skills for Trade & Technical I and II

The ACCESS SKILLS: Vocational Readiness Skills manuals were developed by occupational cluster areas and include the lists from the Vocational Readiness Skills Inventory for Special Needs Students as well as activity suggestions and instructional modules for teaching the different skills necessary for each program area.

MANUAL COMPONENTS

VIMS COMPETENCY LIST

This list is found at the beginning of each program area. Each list contains the exit level skills from the program area taken from the standardized Vocational Instructional Management System (VIMS). Vocational instructors will train students in the majority of these skills and may add skills for an individual student or for all students. It is important to note that not all students must master all of the competencies. The Individual Educational Planning (IEP) team can decide which competencies a student is able to master at what level of acceptance in a given time period. The specified competencies should be designed to lead to a job; that is, a student should be able to learn skills necessary for a job in the community. These competency lists are included so that:

(1) the teacher, student, and parent may see in advance the types of skills which will be presented to students. In this way, the IEP team may have a better idea if the vocational area is reasonable and appropriate for the student;

(2) the relationship between the ACCESS SKILLS: Vocational Readiness Inventory and the exit level competencies can be better understood. For example, in the Automobile Mechanics area:

ACCESS SKILLS Vocational Readiness Inventory	VIMS Exit Competency
MATH Use basic measuring intruments, rulers, scales, etc.	Measure volts with voltmeter Measure current with an ammeter
PHYSICAL DEMANDS/WORKING ENVIRONMENT Ability to work in hazardous conditions, i.e., fumes, odors, toxic conditions, dust, and poor ventilation.	Complete engine assembly and pre-lube Start engine and set fuel and ignition system to manufacturer's specifications
APTITUDES Make visual comparisons and discriminations and see slight differences (P-form perception)	Inspect and repair oil system and components
TEMPERAMENT Situations requiring the precise attainments of set limits, tolerances or standards	Estimate time and cost for for job order parts Reassemble automatic transmission/transaxle, check end-play and adjustments
VOCATIONAL Identify basic hand tools and equipment	Identify the safe use of hand tools Identify the safe use of power tools

The ACCESS SKILLS: Vocational Readiness Inventory lists are very basic skills which are needed across vocational areas; therefore, many of them are the same, even across different vocational areas. However, if a student possesses these basic skills, then the outcome skills (VIMS exit competencies) will be easier for the student to attain.

ACCESS SKILLS CHECKLISTS

Each vocational program manual will contain a summary checklist of the skills needed for the area the student wishes to pursue. After assessing the skills with the ACCESS SKILLS: Generic Informal Assessment Instruments, or other formal or informal assessments, the teacher can transfer the information obtained onto the summary checklist. On the checklist, each ACCESS SKILL is broken down into its component parts and the teacher will designate the student's performance or ability by circling the appropriate mastery code number.

3 = mastery
2 = requires supervision
1 = not mastered
N = no exposure

There is room on the checklist to fill in a mastery date as well as a re-entry code and date for mastery later in the year. After completion of the assessment, the areas of weakness can and should become goals in the IEP. This checklist should be sent to the Area Vocational School as part of the student's application. The codes (3, 2, 1, N) can be entered into the VIMS system if the vocational school desires to follow the student's mastery of skills.

A student does NOT have to show mastery of every skill on the ACCESS SKILLS list in order to enter a vocational program. These skills are negotiable and can continue to be practiced during vocational training. The deficient areas should help the planning team in developing realistic vocational goals and objectives and appropriate vocational training for the student. They also should help vocational personnel identify what skills still need to be practiced and/or what curriculum modifications need to be made to insure the success of the student.

Students with physical limitations may never achieve some of the ACCESS SKILLS, especially in regards to dexterity and other physical demands. This does not preclude them from entering and succeeding in an appropriate vocational area. In these cases, the teacher should make a comment regarding the compensatory techniques the student uses (i.e., strikes typewriter with pencil instead of fingers) and list any modifications that might be needed (i.e., typewriter template, longer time to complete assignments, etc.).

INSTRUCTIONAL ACTIVITIES

This section in each manual is designed to give teachers suggestions for activities that may be used to teach and develop a student's weaker skills found during the assessment. It is assumed that students entering vocational programs have fundamental math skills such as counting, adding, subtracting, multiplying, and dividing one place numerals. The activities usually begin with more advanced skills (working with two place numbers), and all are related to the specific program area the student has chosen.

Each of the five major areas of the ACCESS SKILLS: Vocational Readiness Inventory are covered (math, physical demands/working environment, aptitudes, temperament, and vocational). The activities often overlap, but repetition of previously learned material is often helpful for special needs students. For example, the majority of activities require dexterity skills (writing food orders, typing, handling boxes of different weights). Some activities require basic math skills in adding column totals, etc. However, since the activities are related to job tasks in the vocational area many students will not notice the overlap of skills. Teachers are encouraged to be innovative in developing other activities to enhance the student's ability in any specific area.

The activities include suggestions for parents, and most are written so as to be easily utilized as IEP goals or objectives. The criterion level for mastery is not included, as each student's expected level may differ.

Within each vocational program area a vocabulary list is provided, as well as a tool list, when appropriate. In addition, when worksheets for activities are provided, they are found at the end of the section (math, physical demands, etc.).

INSTRUCTIONAL MODULES

These modules are related to the vocational program area, and have been revised from the instructional modules found in the Entry Level Skills Criterion Manual. Some of the modules can also be found in the ACCESS SKILLS: Employability and Study Skills Assessment and Curriculum Guide, but have been adapted to the specific vocational program area.

RESOURCE MATERIALS

At the end of each program area, a list of resource materials is provided to help supplement the activity suggestions. Names and addresses of publishers are included. An Area Vocational School may already have some of these materials, as might other teachers in the building, so it would be advisable to check with other teachers prior to purchasing.

AUTOBODY REPAIR

Sample Occupational Areas
Autobody Customizer
Autobody Repairer
Autobody Repairer Helper
Automobile Seat Cover Repairer
Painter's Helper, Automotive

Introduction

Autobody repair is a job that requires the ability to work with tools in a step-by-step process to complete a task. Autobody repair sometimes includes repairing the interior trim and upholstery of a car, as well as the actual body of the car.

Welding is an important skill for autobody repair. Students interested in autobody should take a Metals or Welding class either prior to or concurrent with enrollment in the autobody class. Students are exposed to dangerous gases and some toxic fumes, so safety habits are also very important.

VIMS COMPETENCIES FOR AUTOBODY REPAIR

A. Safety

1. Use chemicals safely
2. Use hand tools correctly
3. Use power tools correctly
4. Use protective clothing and equipment
5. Use fire protection equipment
6. Follow Environmental Protectional Agency (EPA) and Occupational Safety and Health Act (OSHA) regulations

Other (specify):

B. Conventional Frame Construction

1. Identify conventional frames
2. Identify the 5 types of damage
3. List frame terminology
4. Use and interpret specification manuals
5. Analyze frame damage using the self-centering datum gauge
6. Analyze frame damage using the tram gauge
7. Analyze frame damage using tape measure
8. Analyze frame damage using universal measuring systems

Other (specify):

C. Unibody Frame Construction

1. Describe evolution of unibody frame
2. Identify unibody frames
3. Identify unibody terminology
4. Identify 4 types of damage
5. Use and interpret specification manuals
6. Analyze unibody damage using the self-centering datum gauge
7. Analyze frame damage using tram gauge
8. Analyze frame damage using tape measure
9. Analyze frame damage using universal measuring systems
10. Analyze frame damage using dedicated measuring systems
11. Identify characteristics and uses of high strength steel
12. Specify proper lifting and jacking techniques

Other (specify):

D. Conventional Frame Repair

1. Straighten and align twist frame damage
2. Straighten and align diamond frame damage
3. Straighten and align mash frame damage
4. Straighten and align sag frame damage
5. Straighten and align sidesway frame damage
6. Describe partial replacement of frame sections
7. Replace component parts
8. Perform stress relief using heat
9. Perform stress relief using shock
10. Apply corrosion protection *

Other (specify):

E. Unibody Structural Repair

1. Straighten and align twist damage *
2. Straighten and align mash damage *
3. Straighten and align sag damage *
4. Straighten and align sidesway damage *
5. Align overall body structure *
6. Repair high strength steel *
7. Replace high strength steel *
8. Replace component parts *
9. Section component parts *
10. Weld unibody structural components *
11. Apply corrosion protection *
12. Remove and reinstall mechanical components *

Other (specify):

F. Steering and Suspension Systems

1. Identify front conventional suspension systems
2. Identify front MacPherson strut suspension systems
3. Identify rear suspension systems
4. Remove and reinstall front suspension systems
5. Remove and reinstall rear suspension systems
6. Remove and reinstall front drive train
7. Service suspension systems
8. Identify conventional steering systems
9. Identify rack-and-pinion steering systems
10. Perform four wheel alignment
11. Diagnose steering and suspension problems
12. Service power steering system
13. Service brake system
14. Identify effects of tires on steering

Other (specify):

G. Welding

1. Service and maintain welding equipment
2. Prepare metal for welding
3. Use weld through primers *
4. Set up and operate equipment for oxyacetylene welding
5. Set up and operate equipment for

---

* Inter-Industry Conference on Auto Collision Repair (I-CAR) Standards

oxyacetylene cutting

6. Construct a corner weld without a filler rod
7. Lay beads on light gauge metal without filler rod
8. Lay beads on light gauge metal with filler rod
9. Weld butt joints with filler rod
10. Perform oxyacetylene weld destructive test
11. Make ninety-degree cuts on 1/8" mild steel plate and restart a cut
12. Make a flame beveled cut on 1/8" mild steel plate
13. Cut a hole in 1/8" mild steel plate
14. Construct a MIG plug weld *
15. Construct a MIG continuous weld *
16. Construct a MIG stitch weld *
17. Pass a MIG weld destructive test *
18. Use appropriate protective clothing and equipment

Other (specify):

H. Panel Repairs -- Sheet Metal

1. Analyze damage
2. Identify nonrepairable panels
3. Align sheet metal
4. Clean the exterior surface
5. Roughout panel
6. Shrink panel
7. Prepare surface for body filler
8. Apply body filler
9. Finish body filler
10. Apply corrosion protection *
11. Use weld-on stud gun to repair sheet metal

Other (specify):

I. Panel Repairs -- Plastic

1. Analyze damage
2. Identify plastic types
3. Align panel
4. Clean exterior and interior surface
5. Perform chemical plastic welding
6. Perform hot air plastic welding
7. Test plastic welds
8. Repair plastic with chemical fillers
9. Replace bolted on panels
10. Repair plastic dash

Other (specify):

J. Panel Repairs -- Fiberglass

1. Analyze damage
2. Align panel
3. Clean exterior and interior surfaces
4. Bond fiberglass panels
5. Reconstruct fiberglass panels
6. Section fiberglass panels

Other (specify):

K. Exterior Moldings and Trim Fasteners

1. Remove and replace belt molding and trim
2. Remove and replace reveal molding and trim
3. Remove and replace driprail scalp molding and trim
4. Remove and install glue-on molding and trim
5. Locate and drill holes for molding and trim
6. Remove and replace decals and stripes
7. Use weld-on stud gun to install molding

Other (specify):

L. Body Panel Replacement

1. Remove and replace cosmetic panels, welded on
2. Remove and replace structural panels, welded on
3. Remove and replace cosmetic panels, bolted on
4. Remove and replace structural panels, bolted on
5. Section non-structural panels, welded on
6. Replace door intrusion barrier
7. Replace bonded door panels
8. Apply corrosion protection *

Other (specify):

M. Glass

1. Remove and replace a gasket type window or back glass
2. Remove and replace glass with urethane sealants
3. Remove and replace door glass, manual
4. Remove and replace door glass, electric
5. Remove and replace door glass regulator, manual
6. Remove and replace door glass regulator, electric
7. Remove and reinstall glass with butyl tape kit
8. Install bonded mirror brackets to windshield
9. Repair heated glass connectors or terminals

Other (specify):

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* Inter-Industry Conference on Auto Collision Repair (I-CAR) Standards

N. Fasteners

1. Identify types of bolts and nuts, US and metric
2. Identify non-reuseable bolts
3. Identify and use headlight fasteners
4. Identify types of rivets
5. Identify types of screws
6. Identify types of clips

Other (specify):

O. Interior Trim

1. Identify repairable trim
2. Remove and replace a clip attached door handle
3. Remove and replace a screw attached door handle
4. Remove and replace lock cylinders
5. Drop and install a headliner
6. Remove and replace a door trim panel
7. Remove and replace seats
8. Remove and replace seat tracks, manual
9. Remove and replace seat tracks, electric
10. Remove and reinstall dash assembly
11. Remove and reinstall heating and air conditioning assembly
12. Remove and reinstall carpeting
13. Remove and reinstall seat belts
14. Service seat belts

Other (specify):

P. Power Tools, Shop Equipment and General Hand Tools

1. Identify, use and maintain electrical tools
2. Identify, use and maintain pneumatic tools
3. Identify, use and maintain hydraulic tools
4. Identify, use and maintain electrical equipment
5. Identify, use and maintain pneumatic equipment
6. Identify, use and maintain hydraulic equipment
7. Identify, use and maintain general hand tools

Other (specify):

Q. Bumpers

1. Align bumpers, steel or aluminum
2. Repair bumper brackets and reinforcements *
3. Repair bumper absorbers *
4. Replace bumper absorbers
5. Remove and replace soft facia covers

Other (specify):

R. Lighting Systems

1. Service a taillight assembly
2. Service a headlight assembly
3. Service mechanical headlights and covers
4. Aim headlights using mechanical aiming equipment

Other (specify):

S. Refinishing (Painting)

1. Prepare surface - new panel
2. Prepare surface - damaged panel
3. Perform featheredging
4. Use metal conditioners
5. Sand for a complete paint job (wet or dry)
6. Select and apply appropriate primer
7. Perform guide coat/block sanding/reprime
8. Select and apply appropriate sealant
9. Select appropriate color coat
10. Apply lacquer
11. Apply synthol enamel
12. Apply acrylic enamel
13. Apply urethane enamel
14. Tint and blend color coat with a panel repair
15. Apply 2-stage system
16. Apply 3-stage system
17. Color, sand and buff
18. Remove and apply aftermarket paint protection
19. Strip painted surfaces using chemicals
20. Apply chip resistant coating
21. Featheredge, sand and prime flexible panel
22. Paint flexible panel
23. Use the paint gun with proper technique
24. Mix paint
25. Mask for urethane primer
26. Mask for a panel repair
27. Mask for a complete paint job
28. Texture dashes
29. Mask and paint stripes

Other (specify):

T. Vinyl Tops

1. Remove and replace vinyl tops
2. Repair vinyl tops
3. Refinish vinyl tops

Other (specify):

* Inter-Industry Conference on Auto Collision Repair (I-CAR) Standards

U. Refinishing Equipment

1. Use appropriate protective clothing and breathing equipment for a painting
2. Service and maintain a paint gun
3. Service and maintain the paint room
4. Clean a pressure pot

Other (specify):

V. Write A Damage Report

1. Diagnose and analyze damage
2. Use collision manuals
3. Write a damage report in logical sequence

Other (specify):

W. Basic Measurement

1. Read a metric rule
2. Solve problems involving volume

Other (specify):

X. Electrical Service

1. Service a battery
2. Describe the relationship between the computer and the battery
3. Install a terminal (soldered and solderless)
4. Splice a wire (soldered and solderless)
5. Troubleshoot electrical system

Other (specify):

Y. Engine Cooling System

1. Remove and replace a water pump
2. Remove and replace a radiator
3. Remove, inspect and replace V-Belts
4. Test antifreeze solution
5. Service fan blades and fan clutches
6. Inspect and service electrical fan motors
7. Check and service radiator and heater hoses

Other (specify):

Z. Air Conditioning

1. Repair or replace condenser
2. Remove and reinstall compressor
3. Test the system for leaks
4. Repair leaks in air conditioning system
5. Evacuate and charge system using vacuum pump or charging system
6. Check and service air conditioning hoses

Other (specify):

AA. Interior Detailing

1. Clean plain interior fabrics
2. Clean coated interior fabrics, genuine leather and molded plastic interior components
3. Clean polyurethane foam interior components
4. Clean painted interior surfaces
5. Clean black rubber interior surfaces and weatherstrip

Other (specify):

Leadership Competencies **

1. Demonstrate an understanding of VICA, its structure and activities
2. Demonstrate an understanding of one's personal values
3. Perform tasks related to effective management skills
4. Demonstrate interpersonal skills
5. Demonstrate etiquette and courtesy
6. Demonstrate effectiveness in oral and written communications
7. Develop and maintain a code of professional ethics
8. Maintain a good professional appearance
9. Perform basic tasks related to securing and terminating employment
10. Perform basic parliamentary procedures in a group meeting

** (Note: These competencies are addressed in the Missouri VICA Curriculum Guide lessons.)

AUTOBODY REPAIR
ACCESS SKILLS CHECKLIST

Student Name/ID ____________________ Sending School ____________________

Instructor ____________________ Date(s) Evaluated ____________________

Circle proper mastery code: 3 = MASTERY 2 = REQUIRES SUPERVISION
1 = NOT MASTERED N or blank = NO EXPOSURE

TASK DESCRIPTION	TASK ID #	MASTERY CODE	MASTERY DATE	RETRY CODE/DATE
1. Count two-place numbers	470699A001	3 2 1 N		
2. Add two-place numbers	470699A002	3 2 1 N		
3. Subtract two-place numbers	470699A003	3 2 1 N		
4. Perform standard units of measure ment, i.e., cup, pint, quart, inch, foot, yard, ounce, pound	470699A004	3 2 1 N		
5. Use basic measuring instruments, i.e., rulers, scales	470699A005	3 2 1 N		
6. Multiply two-place numbers	470699A006	3 2 1 N		
7. Divide two-place numbers	470699A007	3 2 1 N		
8. Add common fractions	470699A008	3 2 1 N		
9. Subtract common fractions	470699A009	3 2 1 N		
10. Multiply common fractions	470699A010	3 2 1 N		
11. Divide common fractions	470699A011	3 2 1 N		
12. Add two-place decimals	470699A012	3 2 1 N		
13. Subtract two-place decimals	470699A013	3 2 1 N		
14. Multiply two-place decimals	470699A014	3 2 1 N		
15. Divide two-place decimals	470699A015	3 2 1 N		
16. Add discount, interest and percentage	470699A016	3 2 1 N		
17. Subtract discount, interest and percentage	470699A017	3 2 1 N		
18. Multiply discount, interest and percentage	470699A018	3 2 1 N		
19. Divide discount, interest and percentage	470699A019	3 2 1 N		
20. Add surface areas, values, weights and measures	470699A020	3 2 1 N		
21. Subtract surface areas, values, weights and measures	470699A021	3 2 1 N		
22. Multiply surface areas, values, weights and measures	470699A022	3 2 1 N		
23. Divide surface areas, values, weights and measures	470699A023	3 2 1 N		
24. Lift 50 lbs. maximum with frequent lifting and/or carrying of objects weighing up to 25 lbs. (Medium work)	470699B001	3 2 1 N		

AUTOBODY REPAIR
ACCESS SKILLS CHECKLIST

Student Name/ID ______________________ Sending School ______________________

Instructor ______________________ Date(s) Evaluated ______________________

Circle proper mastery code: 3 = MASTERY 2 = REQUIRES SUPERVISION
1 = NOT MASTERED N or blank = NO EXPOSURE

TASK DESCRIPTION	TASK ID #	MASTERY CODE	MASTERY DATE	RETRY CODE/DATE
25. Bend body downward and forward by bending the spine at the waist (stooping)	470699B002	3 2 1 N	________	________
26. Bend legs at the knees to come to rest on the knee or knees (kneeling)	470699B003	3 2 1 N	________	________
27. Bend body downward and forward by bending the legs and spine (crouching)	470699B004	3 2 1 N	________	________
28. Move about on the hands and knees or hands and feet (crawling)	470699B005	3 2 1 N	________	________
29. Extend the hands and arms in any direction (reaching)	470699B006	3 2 1 N	________	________
30. Seize, hold, grasp, turn or otherwise work with the hand or hands (handling)	470699B007	3 2 1 N	________	________
31. Pick, pinch, or otherwise work with the fingers (fingering)	470699B008	3 2 1 N	________	________
32. Perceive size, shape, temperature or texture of objects and materials by using fingertips (feeling)	470699B009	3 2 1 N	________	________
33. Ability to work inside	470699B010	3 2 1 N	________	________
34. Ability to work in extreme noise, constant or intermittent, causing marked distraction or possibly injury to hearing	470699B011	3 2 1 N	________	________
35. Ability to work in extreme vibration, i.e., strain on body or extremities from repeated motion or shock	470699B012	3 2 1 N	________	________
36. Ability to work in hazardous conditions, i.e., fumes, odors, toxic conditions, dust and poor ventilation	470699B013	3 2 1 N	________	________
37. Coordinate eyes and hands or fingers rapidly and accurately (K-motor coordination)	470699C001	3 2 1 N	________	________
38. Make a movement response accurately and swiftly (K-motor coordination)	470699C002	3 2 1 N	________	________
39. Move the fingers and manipulate small objects with the fingers, rapidly or accurately (F-finger dexterity)	470699C003	3 2 1 N	________	________
40. Move the hands easily and skillfully (M-manual dexterity)	470699C004	3 2 1 N	________	________

AUTOBODY REPAIR
ACCESS SKILLS CHECKLIST

Student Name/ID ______________________ Sending School ______________________

Instructor ______________________ Date(s) Evaluated ______________________

Circle proper mastery code: 3 = MASTERY 2 = REQUIRES SUPERVISION
1 = NOT MASTERED N or blank = NO EXPOSURE

TASK DESCRIPTION	TASK ID #	MASTERY CODE	MASTERY DATE	RETRY CODE/DATE
41. Work with the hands in placing and turning motions (M-manual dexterity)	470699C005	3 2 1 N	________	________
42. Match or discriminate between colors	470699C006	3 2 1 N	________	________
43. Identify a particular color or color combination	470699C007	3 2 1 N	________	________
44. Perceive contrasting color combinations	470699C008	3 2 1 N	________	________
45. Situations requiring the precise attainment of set limits, tolerances, or standards	470699D001	3 2 1 N	________	________
46. Performing a variety of duties, often changing from one task to another of a different nature without loss of efficiency or composure	470699D002	3 2 1 N	________	________
47. Identify basic hand tools and equipment	470699E001	3 2 1 N	________	________
48. Use basic hand tools and equipment	470699E002	3 2 1 N	________	________
49. Demonstrate knowledge of basic safety concepts	470699E003	3 2 1 N	________	________

AUTOBODY VOCABULARY LIST

ACETYLENE	a gas made from carbon and hydrogen and used in welding
ADAPTORS	fittings used to attach components of different sizes to each other
ADJUSTER	person who checks vehicle damage and makes estimates of the repair costs for an insurance company
ALIGN	to adjust panels or other components to a specified tolerance, as when lining up a door to a fender to gain the correct spacing
AMPERE	a unit of electric current
ARC SPOT WELDER	electrically operated equipment which utilizes a rod and an arc to join small areas of metal together
BASE COAT	undercoat used as a foundation for the top coat of paint
BEAD	the amount of filler metal deposited when welding two pieces of metal or plastic
BLEEDTHROUGH	paint condition occurring when old finish shows through the new finish
BRAZING	soldering metals together with an alloy, usually a brass rod, which melts at a lower temperature than that of the metals being joined
BUFFING	polishing a painted surface with a buffer
CATALYST	a substance used to make plastic body filler harden
CFM	cubic feet per minute
CHASSIS	the vehicle frame when combined with the engine, drive train, and running gear
CIRCUIT	the complete path of an electric current
CLAIMANT	person who initiates a claim against an insurance company for auto body damage incurred
CLEARANCE SPECIFICATIONS	the amount of space required between door and fender, deck lid and quarter panel, etc.
COMBINATION BODY AND FRAME CONSTRUCTION	a type of auto body in which the body and frame are built separately and bolted together

COMPONENT	part, panel, or piece of a finished product
CONTAMINANTS	grease, wax, dirt, or other foreign materials which can ruin a paint job
CONTOURS	curved or rounded areas on automobile panels, such as crowns and flanges
CRASH MANUAL	a manual published by manufacturers to aid in the making of estimates. It lists parts and gives the order of assembly, along with diagrams
CURING TIME	the period of time, as determined by the manufacturer, required for a material, such as plastic adhesive or filler, to harden
DIAMOND CONDITION	a type of understructure damage in which one side of the vehicle has been moved to the front or rear, causing the frame and/or body to be out-of-square
ELASTICITY	the property of metal which causes it to resist distortion and thereby recover its original shape
ELECTRODE	a flux-coated rod used in arc welding
FEATHEREDGING	tapering the rough edges of a painted or body filler surface in preparation for applying primer surface
FLOOR PANS	the many panels which are joined together to make up the bottom portion of the auto body
FLUX	a compound used in brazing, soldering, and welding to dissolve and/or prevent the formation of unwanted inclusions
FRAME	the part of an automobile to which the body, rear end, front suspensions, and other body components are attached
GAUGE	the thickness of sheet metal
GRILLE	trim component which covers front support panels and radiator assembly
HARDTOP BODY STYLE	an automobile body designed without a roof-supporting center pillar
HEADLINING	the overhead fabric in the interior of a vehicle
HOOD PANEL	outer front panel which covers the engine compartment
HP	horsepower

HYDROMETER	an instrument used for checking the amount of electrolyte in a battery
LASER BEAM ALIGNER	alignment equipment for diagnosis and repair which utilizes a laser beam for determining proper measurement
LOCK PILLAR	upright member located between doors or, in two-door hardtops or convertibles, between rear quarter panel and door
MACPHERSON STRUT	a coil spring enclosed shock-absorbing suspension member
MASH DAMAGE	a buckling of the frame; usually the result of a front or rear direct hit
MECHANISMS	the working parts in any assembly or component
MISALIGNED	not in proper alignment; having an uneven spacing or surface between panels or other components
MOON ROOF (MOON TOP)	a power-operated, factory-installed sliding glass roof panel
NEUTRAL FLAME	welding flame in which there is a balance of both oxygen and acetylene
OUTER PANELS	sheet metal body components which are bolted or welded to inner panels to form the exterior of the automobile body
PARCEL SHELF	area between the back seat and rear window of a vehicle
PILLAR	a post which separates glass areas, such as a windshield pillar, door pillar, etc.
POSITIVE POST	the positive terminal on a battery, usually colored red or marked with a + for identification
PRIMER	undercoating or base coat for paint
PRIMER-SEALER	a dual-purpose undercoat which requires little sanding and seals small cracks
PSI	pounds per square inch
QUARTER PANEL	outside fender behind the rear doors; sometimes called rear fender panel
REAR COMPARTMENT LID	deck or trunk cover over the luggage compartment

RESPIRATOR	a protective nose and mouth mask used to filter out dust, paint, and other particles
ROCKER PANEL	a small, narrow body panel found beneath the doors of the vehicle
ROOF CLIP	the complete roof assembly as removed from a salvage vehicle
RPM	revolutions per minute
SAFETY GOGGLES	protective goggles worn over the eyes
SAFETY STAND	metal support placed under a raised vehicle
SCRIBE	to mark a line with a sharp object
SECTIONING	replacing only the damaged portion of a panel
SERVICE MANUALS	guides printed by manufacturers to assist the technician in step-by-step repair of components
SIDE ROOF RAILS	support panels on the side of an auto body which help support the roof assembly
STATIONARY SECTIONS	metal panels that will not move; usually welded or fastened rigidly
STEP PLATE	a metal plate which extends from the front floor mat to the door opening
SUBASSEMBLY	an individual part of a body component prior to welding
SUSPENSION	that part of the front end assembly which fastens the wheels to the frame
TACK RAG	a chemically treated cloth used to remove dust from the vehicle surface just before painting
TEMPERED GLASS	glass which has been heat tempered. It shatters into very small pieces when broken
TEMPLATE	a paper or cardboard pattern used for marking a panel prior to drilling or cutting
TERMINALS	ends of battery cables, or special wire ends
TOXIC FUMES	fumes which can cause illness or respiratory difficulties
TRACKING	extent to which the rear wheels follow the front wheels correctly

TRANSAXLE ASSEMBLY	an assembly consisting of both the transmission and differential mechanisms
TRIM	moldings, bumpers, grilles, and other bright metal components on a vehicle
TRIM PANEL	vinyl or cloth decorative panel used to cover the interior of door and other panels
T ROOF (T TOP)	a roof assembly consisting of two removable panels separated by a center support beam
UNDERBODY	the passenger compartment floor panels, trunk floor panels, brackets, braces, etc. which form the lower part of the auto body
UNITIZED BODY CONSTRUCTION	a type of auto body formed from panels welded together to provide overall rigidity and strength
VENTILATOR WINDOW ASSEMBLY	small window assembly located on front doors of some vehicles sometimes called a vent glass assembly
WEATHERSTRIPPING	rubber molding placed around doors, deck lids, etc. to keep out dust and water
WELDING	fusing two pieces of metal together through a heat process
WHEEL HOUSE PANEL	an inner panel assembly forming a partial enclosure for a front or rear wheel
WINDOW CHANNELS	guides for window glass to move in

TOOLS FOR AUTOBODY REPAIR

Arc welding equipment

Air compressor

Ball peen hammer

Body spoons

Dinging hammer

Disc grinder

Dolly block

Drill press

Electric drills

Hacksaw

Hydraulic jacks

Oxyacetylene welding equipment

Pick tools

Pliers

Pneumatic speed sander

Pop rivet tool

Reamer

Sanding drum

Screwdrivers

Solder gun

Tap and die

Torque wrench

Wrenches

AUTOBODY REPAIR

Math Skills

Count two place numbers
Add two-place numbers
Subtract two-place numbers
Perform standard units of measurement, i.e., cup, pint, quart, inch, foot, yard, ounce, pound
Use basic measuring instruments, i.e., rulers, scales
Multiply two-place numbers
Divide two-place numbers
Add common fractions
Subtract common fractions
Multiply common fractions
Divide common fractions
Add two-place decimals
Subtract two-place decimals
Multiply two-place decimals
Divide two-place decimals
Add percentage
Subtract percentage
Multiply percentage
Divide percentage
Add surface areas
Subtract surface areas
Multiply surface areas
Divide surface areas

NOTE: Many math books and workbooks provide needed direction in learning basic operations in math. This section assumes that students have basic skills and is designed to be used in conjunction with any of the math books you might be using, or to establish your own supplemental units. Any math practice activities should be developed within the context of the vocational program. Other persons to use as resources in this area include: parents, math teacher, and industrial arts teacher.

1. Most autobody repair persons use time sheets to turn in the hours they worked during the week. Given Worksheet AB #1, student will complete four timesheets with 100% accuracy.

   Answers to Worksheet AB #1:

   1. Total Hours Worked - 43
   2. Total Hours Worked - 40
   3. Total Hours Worked - 47
   4. Total Hours Worked - 41

2. Given Worksheet AB #2, explain to student that the rows and columns must both be added to complete the form. Student will complete the worksheet with 100% accuracy.

   Answers to Worksheet AB #2:

Name	Total Hours	Day	Total Hours
Smith	39	Mon	33
Black	42	Tues	49
Jones	35	Wed	43
Johnson	43	Fri	49
Broad	45	Sat	15
James	42	Sun	7

3. If a student needs help with fractions refer to the Instructional Module "Perform Basic Operations Using Fractions" found in the last section of this manual.

4. Given sample problems using money (decimals), student will demonstrate ability to perform basic operations using decimals.

5. Student will practice skills in finding square feet and cubic feet by using the Instructional Module "Figure Square Feet and Cubic Feet" found in the last section of this manual.

6. Given Worksheet AB #3, student will correctly answer 8 out of 10 percentage questions.

Answers to Worksheet AB #3:

1. $765.00
2. $70.00
3. $194.00
4. $467.50
5. a
6. $.70
7. .60 or 60%
8. 4
9. $70.00
10. $1209.00

SUGGESTIONS FOR PARENTS:

1. When mixing foods, cleaning fluids, etc. at home, teach student about ratio or proportion (i.e., 4:1 means 4 parts of one substance to 1 part of another).

2. Encourage student to measure objects around the home.

AB #1

WORKSHEET

TIMESHEETS

Directions: Complete these timesheets by adding the hours worked each day then add the total hours worked for the week.

No. 1
Name:________________
Week Ending____________ 19__

	A.M.		P.M.		Hours Worked
	In	Out	In	Out	
Mon.	8:00	12:00	1:00	5:00	
Tues.	8:30	12:00	12:30	4:00	
Wed.	8:00	12:00	12:30	3:30	
Thurs.	8:00	12:00	12:30	5:30	
Fri.	8:00	11:30	12:00	5:30	
Sat.	---	---	---	---	
Sun.	9:00	12:00	---	---	

Total Number of Hours Worked

No. 2
Name:________________
Week Ending____________ 19__

	A.M.		P.M.		Hours Worked
	In	Out	In	Out	
Mon.	8:00	11:30	12:30	5:00	
Tues.	7:30	12:00	---	---	
Wed.	8:00	12:00	1:00	5:00	
Thurs.	8:00	12:00	1:00	5:00	
Fri.	8:00	12:00	2:00	5:00	
Sat.	8:00	12:30	---	---	
Sun.	---	---	---	---	

Total Number of Hours Worked

AB #1
cont.

WORKSHEET

TIMESHEETS

No. 3
Name:________________
Week Ending____________ 19__

	A.M.		P.M.		Hours Worked
	In	Out	In	Out	
Mon.	8:00	1:00	2:00	4:00	
Tues.	8:00	12:00	1:00	5:00	
Wed.	8:00	12:00	1:00	3:00	
Thurs.	8:00	12:00	1:00	7:00	
Fri.	8:00	12:00	1:00	5:00	
Sat.	8:00	12:00	1:00	5:00	
Sun.	---	---	---	---	

Total Number of Hours Worked

No. 4
Name:________________
Week Ending____________ 19__

	A.M.		P.M.		Hours Worked
	In	Out	In	Out	
Mon.	---	---	1:00	5:00	
Tues.	8:00	12:00	1:00	5:00	
Wed.	8:00	12:00	1:00	5:00	
Thurs.	8:00	12:00	1:00	6:00	
Fri.	8:00	12:00	1:00	5:00	
Sat.	---	---	---	---	
Sun.	9:00	1:00	---	---	

AB #2

WORKSHEET

WEEKLY HOURS

Directions: Complete this form by adding each persons hours all week. Then add the daily total (Mon, Tues, etc.) Finally find the total number of hours worked for the week.

EEE AUTOBODY SHOP

Time Record: Weekly Hours

Week Ending.................................... 19....

Employee	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.	Sun.	Total
A. Smith	7	8	8	9	7	--	--	39
B. Black	4	9	7	8	10	4	--	
C. Jones	--	7	7	9	9	--	3	
A. Johnson	9	9	6	7	8	4	--	
G. Broad	6	7	8	10	7	3	4	
K. James	7	9	7	7	8	4	--	
TOTAL	33							

WORKSHEET

PERCENTAGE

Directions: Solve these problems.

1. John is interested in buying one of the cars you have repaired. It costs $850.00, but you will give John a 10% discount. What will John pay for the car? ______________

2. You can order weatherstripping at a 30% discount. Normally it costs $2.00 a foot. You order 50 feet. How much do you pay? ______________

3. You take home $151.32 a week. This is 78% of your gross pay (before deductions). What is your weekly gross pay? ______________

4. You have ordered tools which cost $550.00. If you pay the bill before the 10th day of the month, you get a 15% discount. What is your cost if you pay the bill on the 5th day of the month? ______________

5. Which is the better buy?

   (a) Convertible top listed at $650 with a 25% discount? or
   (b) A convertible top of equal quality listed at $600 with a 5% discount? ______________

6. Your shop uses a 15% mark-up on all small parts sold. Your cost for retaining clips is 30 cents a clip. What is the cost to a customer of 2 clips? ______________

7. Business has been slow and you decide to offer a discount "wash and wax". Materials and labor for a one car "wash and wax" usually runs $20.00. You offer this service for $12.00. What is the discount in percent form? ______________

AB #3
cont.

8. You had 40% of your workers sick on Tuesday. There are a total of 10 workers in your shop. How many were sick? ______________

9. Your shop has run out of autobody putty and has to finish a customer car. You have to buy the putty at retail prices which are 25% higher than your usual wholesale price. The wholesale price for the amount needed is $56.00. How much is the retail price? ______________

10. The insurance costs to run your shop have gone up 55% over the last five years. Five years ago you paid $780.00 for insurance. What do you pay at today's prices? ______________

Physical Demands/Working Environment

Lift 50 lbs. maximum with frequent lifting and/or carrying of objects weighing up to 25 lbs. (Medium work)
Bend body downward and forward by bending the spine at the waist (stooping)
Bend legs at the knees to come to rest on the knee or knees (kneeling)
Bend body downward and forward by bending the legs and spine (crouching)
Move about on the hands and knees or hands and feet (crawling)
Extend the hands and arms in any direction (reaching)
Seize, hold, grasp, turn or otherwise work with the hand or hands (handling)
Pick, pinch, or otherwise work with the fingers (fingering)
Perceive size, shape, temperature or texture of objects and materials by using fingertips (feeling)
Ability to work inside
Ability to work in extreme noise, constant or intermittent, causing marked distraction or possibly injury to hearing
Ability to work in extreme vibration, i.e., strain on body or extremities from repeated motion or shock
Ability to work in hazardous conditions, i.e., fumes, odors, toxic conditions, dust and poor ventilation

In most cases, the assessment of these skills will indicate that the student has the gross and fine motor skills which are prerequisites to learning the vocational skills in a Autobody Repair. Prior to instruction in any physical demands activities, the student should have been evaluated and parents contacted to make sure that the student has no hidden physical problems that could be aggravated by lifting objects or by other physical activities done in this area. However, if the student has a physical disability or other limitation(s) preventing him/her from demonstrating fine and gross motor skills, then other techniques may be taught so he/she can perform in the vocational program. Other persons to use as resources in this area include: physical education teacher, industrial arts teacher, special education teacher, and parents.

1. To insure proper lifting techniques, student will work through the instructional module, "Physical Demands Movements" found in the last section of this book.

2. Student will identify objects weighing between 25 and 50 pounds, and, using proper lifting techniques, lift and carry an object weighing 20-25 pounds.

3. Given an assortment of 6-8 different grades of sandpaper (cut into different sizes and shapes), student will sort the pieces according to texture, then according to size, then according to shape. Using a blindfold, student will again sort according to texture, using fingers to determine differences.

4. Student will either state or write his/her personal medical history, paying special attention to any allergies or conditions which may get worse working around paint, dust, and toxic fumes.

5. Student will visit an autobody shop (perhaps at the area vocational school) and report on the noise and environment (working conditions) and how he/she feels about them.

SUGGESTIONS FOR PARENTS:

1. Report to the teacher your impressions of the student's ability to work around vibration, noise and toxic fumes.

2. Visit an autobody repair shop and discuss with student the environment and activities found there.

AUTOBODY REPAIR

Aptitudes - indicates an ability to:

coordinate eyes and hands or fingers rapidly and accurately (K-motor coordination)
make a movement response accurately and swiftly (K-motor coordination)
move the fingers and manipulate small objects with the fingers, rapidly or accurately (F-finger dexterity)
work with the hands in placing and turning motions (M-manual dexterity)
match or discriminate between colors
identify a particular color or color combination
perceive contrasting color combinations

Other persons to use as resources in this area include: parents, industrial arts teacher, and counselor (aptitude test scores).

1. Obtain information on gross and fine dexterity skills from the Industrial Arts teacher or the Physical Education teacher.

2. From a hardware or paint store, collect lots of paint color strips. Student will find magazine pictures to match different paint colors on the strip.

3. Student will work through the instructional module, "Identify Basic Parts of the Automobile", found in the last section of this manual.

4. Contact a used auto yard and request donations of unsalable small parts and an old catalog. Student will identify the parts using the catalog.

5. Student will develop a list of basic colors and create names to describe the colors (i.e. fire engine red, barn red, etc.)

6. Student will use masking tape to tape all desk handles and file cabinet handles in preparation for painting. (Have student remove tape when done).

SUGGESTIONS FOR PARENTS:

1. Encourage student to clean out the home work area, sorting screws, washers, etc. by size and shape.

2. Allow student to pick color(s) for his/her bedroom and paint it (with supervision if necessary).

AUTOBODY REPAIR

Temperament - Indicates an ability to adapt to:

situations requiring the precise attainment of set limits, tolerances, or standards

performing a variety of duties, often changing from one task to another of a different nature without loss of efficiency or composure

Other persons to use as resources in this area include: observations from parents and all other teachers of the student, and employer, if applicable.

1. Given Worksheet AB #4, student will answer the questions using the charts.

   Answers to Worksheet AB #4:

Length	Area	Weight
1. .083 333	1. 1	1. 16
2. .914 402	2. 1296	2. 2.204 62
3. 2.540 01	3. 1	3. 1

2. Explain to student that he/she will be asked to change tasks frequently over the next week (or given time period). State that he/she needs to demonstrate the ability to do this and remain at a high level of production.

SUGGESTIONS FOR PARENTS:

1. Observe student for the ability to change tasks frequently and report observations to teacher.
2. Require that tasks completed are of high quality or have student do it over.

WORKSHEET
CHARTS

AB #4

Length Equivalents

Unit	Millimeters	Centimeters	Meters	Inches	Feet	Yards
1 Millimeter =	1	0.1	0.001	0.039 37	0.003 281	0.001 094
1 Centimeter =	10	1	0.01	0.393 7	0.032 808	0.010 936
1 Meter =	1000	100	1	39.37	3.280 83	1.093 61
1 Inch =	25.4001	2.540 01	0.025 400	1	0.083 333	0.027 778
1 Foot =	304.801	30.480 1	0.304 801	12	1	0.333 33
1 Yard =	914.402	91.440 2	0.914 402	36	3	1

1. 2.540 01 centimeters = ______________ feet.
2. 1 yard = ____________ meters.
3. 1 inch = ____________ centimeters

Area Equivalents

Unit	Square Inches	Square Feet	Square Yards	Square Meters
1 Sq. Foot =	144	1	0.1111	0.092 90
1 Sq Yard =	1296	9	1	0.836 13
1 Sq. Metre =	1550	10.7639	1.195 99	1
1 Sq. Rod =	39 204	272.25	30.25	25.293
1 Are =	155 000	1076.39	119.599	100
1 Sq. Mile (640 Acres) =	-----	27 878 400	3 907 600	2 589 999
1 Sq. Kilometer =	-----	10 763 867	1 195 985	1 000 000

1. 9 square feet =_______________ square yards.
2. 1 square yard =_______________ square inches.
3. 144 square inches =______________ square foot.

Weight Equivalents

Unit	Ounces	Pounds	Grams	Kilograms
1 Ounce =	1	0.062 5	28.349 5	0.028 350
1 Pound =	16	1	453.592	0.453 592
1 Gram =	28.249 5	0.002 205	1	0.001
1 Kilogram =	35.274 0	2.204 62	1000	1

1. 1 pound =_____________ ounces.
2. 1 kilogram =___________ pounds.
3. 28.349 5 grams =__________ ounces.

AUTOBODY REPAIR

Vocational

Identify basic hand tools and equipment
Use basic hand tools and equipment
Demonstrate knowledge of basic safety concepts

1. Using the list at the front of the autobody repair section, student will locate these tools in the industrial education classroom, visit to the area vocational school or field trip to a community autobody shop.
2. Student will locate the above tools in a tool catalog and write the name of the tool and its price.
3. Ask the industrial arts teacher about the student's ability to use hand tools, if the student has had, or is currently enrolled in, this class.
4. After studying Worksheet AB #5, student will state or write 10 safety precautions for welding.
5. After studying Worksheet AB #6, student will state or write 10 safety precautions when using tools.

SUGGESTIONS FOR PARENTS:

1. Allow student to use basic hand tools at home (such as screwdrivers, hammers, wrenches, etc.).
2. Ask student to inspect the home and write out any safety problems seen.

WORKSHEET
WELDING SAFETY

Safety should be observed at all times when oxygen and acetylene gases are present. The following is a review of general safety precautions for working with oxyacetylene equipment.

1. Always wear protective goggles and clothing. Permanent eye damage will result from continuous welding and brazing without proper goggles.

2. Never weld, braze, or heat metal near gasoline tanks, lines, and filler openings.

3. Equipment should be in good condition and checked before use.

4. Never light the torch while it is directed toward supply cylinders or toward other persons.

5. Stay alert at all times. Carelessness eventually results in personal injury and/or property damage.

6. Before starting any operation, check the surrounding area for flammable materials such as cleaning rags, insulation, undercoating, paints, and solvents. Remove all such items from the area.

7. Always protect the interior of the vehicle from sparks and heat. Removal of interior may be necessary in some cases.

8. Always use the lighter provided to ignite gases. Matches and other flames should never be used to light the oxacetylene torch.

9. Be careful of flashback (fire inside the torch). This dangerous condition can occur when a) the cutting tip is loose or overheated, b) the torch body has a bad "O" ring, c) the tip is dirty, or d) the oxygen or acetylene pressure is too low. If flashback occurs, shut down the torch immediately and check out the problem.

10. Avoid backburning (letting the flame burn back into the tip). Should this occur, close the oxygen preheat valve, oxygen torch valve, and acetylene torch valve. Then release both the oxygen and acetylene regulator screws. Examine the acetylene unit for a dirty, clogged, or loose tip. Correct the problem. Reset regulator pressures and light the torch.

11. For oxacetylene cutting, place a slag box beneath the material being cut. A slag box contains water and/or sand. It is used to catch hot slag.

12. Follow all rules and procedures given by the equipment manufacturer and the teacher.

13. Always wear safety goggles with Shade 5 or 6 lenses.

14. Gauntlet gloves and protection for upper arms and body should be worn to protect you from molten iron oxide.

15. All flammable and explosive materials should be removed from the area of operation. The high pressure oxygen can propel heated molten oxide for distances of fifty to sixty feet.

16. It is recommended that the student doing cutting operations have another student standing nearby with a fire extinguisher and keeping watch, in case a fire is started from the spray of hot metal. After the cutting operation is completed, a thorough inspection of the surrounding area is necessary. Fires have been known to kindle hours later, when no one is present.

17. The operator should check that all student traffic is halted in the surrounding area. Screens should be set up as an additional precaution.

WORKSHEET

SAFETY RULES FOR TOOLS

Observe the following precautions when using hand tools:

1. Wear safety glasses whenever using a hammer against metal. Striking against the metal may cause chips of paint or rust particles to fly up. Hot metal fragments resulting from heat shrinkage of metal panels are another source of danger, as is broken glass which has become trapped between panels. The glass pieces will sometimes fly upward when the surrounding metal is struck with a hammer.

2. Exercise special care when using the piercing punch to avoid touching jagged metal edges on the inside of the auto body panel.

3. Never use a file which is not properly fitted with a handle. The pointed tang may injure your palm if pressure is applied suddenly.

4. Take care whenever removing particles of body filler which have become lodged in the grater file cutting surfaces.

5. Whenever using the bumper bracket tool, take special care to position the tool correctly so that it will not slip when pressure is applied.

6. Use only suction cups that are in good condition for holding or positioning glass. A suction cup which has deteriorated to the point where its holding power is lessened is likely to come loose from the glass, causing glass breakage as well as possible injury.

Safety while grinding is important to both the operator and fellow worker. Learn the following rules and practice them constantly until they become established habits:

7. Always follow the procedures recommended by the manufacturer and by your instructor.

8. Always wear approved protective eye goggles with clear lenses while operating the grinder. Make sure that all nearby workers and observers are also wearing approved safety goggles before beginning grinding operations.

9. Wear a respirator when grinding paint, plastic body fillers, and other caustic materials.

10. Start and stop the grinder near the area where the tool is to be used.

11. Never change the abrasive disc or special attachments while the tool is connected to the power source.

12. Never lay the disc grinder on the floor until it has completely stopped turning.

13. Never grind near flammables such as paints, thinners, and reducers or near gasoline tank openings.

14. When using the electric grinder, always check for frayed cords and unsafe plugs.

15. Be sure that the electric grinder is properly grounded.

16. Never use the electric grinder while standing on a wet floor.

17. Stand or kneel in such a position that you will not be thrown off balance if the abrasive disc is suddenly stopped.

18. Keep a firm grasp on the tool at all times.

19. Keep alert at all times. Do not talk to others when grinding. Keep your mind on your work.

RESOURCES

AUTOBODY REPAIR

Barron's Educational Series, Inc.
113 Crossways Park Drive
Woodbury, NY 11797

Survival Mathematics, Williams, E.

Bennett Publishing Co.
809 W. Detweiller Dr.
Peoria, IL 61615

Autobody Repair, 2nd ed. Duenk, L.G., Williams, W.R., and Brooks, C.A.

Educational Design, Inc.
47 West 13 St.
New York, NY 10011

Math: For the World of Work, Crowell, C.E.

Instructional Materials Lab
908 Woodson Way
University of Missouri-Columbia
Columbia, MO 65211

Auto Body Vocabulary Modules (slide/tape)

Instructional Materials Service
Texas A & M University
F.E. Box 2588
College Station, TX 77843-2588

Auto Body Repair Curriculum

AUTO MECHANICS

Sample Occupational Areas:
Tune-up Mechanic
Ignition and Carburetor Mechanic
Front End Mechanic
Brake Repairer
Muffler Installer

There are many different kinds of entry level jobs in the field of auto mechanics. Vocational schools try to teach many of the areas in a two year (3 hour a day) course. Often it is most helpful for the student interested in auto mechanics to enroll in related coursework prior to the auto mechanics program. Some of these related courses might be: small engine repair, welding, metal working, and basic electronics. Math skills are also important, especially in relation to decimals, fractions and conversions.

A student interested in auto mechanics should have good spatial abilities (to see how parts fit together), be in good physical health (for some heavy lifting requirements), be able to handle tools, be willing to get dirty when working as well as work in extreme temperatures (hot and cold). Many aspects of engines today are computerized, so students will be required work with sophisticated machinery. Speed and high quality of work is also important, especially if students plan to work in car dealerships, where the job is costed out at a flat rate (i.e. it should take a certain number of minutes to do a certain task).

Students who desire to enter this field shoud also be able to obtain a driver's license. An instructional module is available in this manual to help them pass the written test.

VIMS COMPETENCIES FOR AUTO MECHANICS

SHOP OPERATION AND SAFETY

A. Safety

1. Identify the safe use of chemicals
2. Identify the safe use of hand tools
3. Identify the safe use of power tools
4. Identify the safe use of protective clothing and equipment
5. Identify the safe use of fire protection equipment
6. Identify the safe use of shop equipment
7. Follow Environmental Protection Agency (EPA) and Occupational Safety and Health Act (OSHA) regulations

B. Shop Operation

1. Communicate with customers and write repair orders
2. Estimate time and cost for job and order parts
3. Obtain appropriate repair information from shop manuals
4. Practice clean and orderly work habits (vehicle, tools and work area)

ENGINE REPAIR

A. General Engine Diagnosis-Remove and Replace

1. Conduct performance tests and determine needed repair
2. Remove and replace engine (front-and real-wheel drive)

B. Cylinder Head and Valve Train Diagnosis and Repair

1. Remove cylinder head(s)
2. Install cylinder head(s)
3. Recondition cylinder head
4. Inspect and replace cam and related components

C. Short Block Diagnosis and Repair

1. Inspect and replace pans, covers, gaskets, and seals
2. Disassemble, inspect and clean short block assembly
3. Check and record short block measurements
4. Check and record component measurements
5. Clean and prep block and components for reassembly
6. Reassemble short block components using correct lubricants, gaskets and sealers

D. Engine Completion and Start-up Procedure

1. Complete engine assembly and pre-lube
2. Start engine and set fuel and ignition system to manufacturer's specifications

E. Lubrication and Cooling System Diagnosis and Repair

1. Inspect and repair oil system and components
2. Perform cooling system tests; determine needed repairs
3. Inspect, replace and adjust drive belts and hoses
4. Replace cooling system components (thermostat, radiator, controllers)
5. Inspect coolant, drain, flush and refill cooling system with recommended coolant
6. Perform oil and lube service on turbo and non-turbo engine

AUTOMATIC TRANSMISSION/TRANSAXLE

A. In-car Transmission/Transaxle Diagnosis and Maintenance

1. Diagnose, performance test transmission/transaxle and determine needed repair
2. Service transmission and perform adjustments
3. Inspect, adjust, and replace sensors and cables
4. Inspect and replace external bushings seals, and gaskets
5. Inspect, replace and align power train mounts

B. Off-car Transmission/Transaxle Repair

1. Remove, disassemble, and clean transmission/transaxle assembly
2. Clean and inspect oil pump and converter
3. Clean and inspect gear train, shafts, bushings, and case
4. Clean and inspect friction and reaction units
5. Reassemble automatic transmission/transaxle assembly

MANUAL DRIVE TRAIN AND AXLES

A. Clutch Diagnosis and Repair

1. Diagnose, performance test, and determine needed repair
2. Replace and adjust clutch assembly

B. Manual Transmission/Transaxle Diagnosis and Repair

1. Diagnose, performance test, and determine needed repair
2. Remove, disassemble, inspect and clean manual transmission/transaxle and shift linkages
3. Reassemble manual transmission/transaxle assembly, check end-play and adjustments

C. Drive Shaft, Diagnose and Repair

1. Diagnose and determine needed repairs
2. Inspect, service, and replace front axle shafts
3. Inspect, service and replace drive shafts

D. Differential Diagnosis and Repair

1. Diagnose and determine needed repairs
2. Disassemble, clean and inspect differential assembly
3. Reassemble and adjust differential assembly

E. Four-Wheel Drive Diagnosis and Repair

1. Diagnose and determine needed repairs on transfer case
2. Disassemble, inspect and clean transfer case
3. Reassemble and adjust transfer case
4. Diagnose and determine needed repairs on hub assemblies
5. Disassemble, clean and inspect hub assemblies
6. Reassemble and adjust hub assemblies

SUSPENSION AND STEERING SYSTEMS

A. Steering Systems

1. Diagnose and determine needed repairs on steering systems
2. Clean and inspect power and manual steering gear boxes
3. Reassemble and adjust power and manual steering gear boxes
4. Clean and inspect power and manual rack-and-pinion steering rack
5. Reassemble and adjust power and manual rack-and-pinion steering rack
6. Inspect and replace steering columns
7. Inspect and replace steering linkage components
8. Inspect and repair power steering pumps

B. Diagnose and Repair Front Suspension System

1. Diagnose and determine needed repairs on conventional front suspension systems
2. Inspect and repair control arm and spring assemblies on conventional systems
3. Inspect and repair wheel spindles and bearings
4. Inspect and replace shock absorbers and stabilizer bars
5. Diagnose and determine needed repairs on MacPherson Strut assemblies
6. Clean, inspect and assemble MacPherson strut assemblies

C. Diagnose and Repair Rear Suspension Systems

1. Diagnose and determine needed repairs
2. Inspect and replace shock and spring assemblies
3. Inspect and replace MacPherson strut assemblies
4. Inspect and repair suspension linkages and bushings

D. Tire and Wheel Alignment Diagnosis and Repair

1. Diagnose steering and tire wear problems
2. Set correct alignment angles on front wheels
3. Set correct camber and toe on rear wheels
4. Rotate and balance tire and wheel assemblies

BRAKES

A. Diagnose and Repair Hydraulic Systems

1. Diagnose hydraulic brake systems and determine needed repairs
2. Inspect and repair or replace master cylinders and lines of the hydraulic system
3. Inspect and replace switches and valving devices

B. Diagnose and Repair Drum Brakes

1. Diagnose and determine needed repairs on drum brake systems
2. Remove, clean and inspect drum brake assemblies
3. Repair, replace and adjust drum brake components

C. Diagnose and Repair Disc Brakes

1. Diagnose and determine needed repairs on disc brake systems
2. Remove, clean and inspect disc brake components
3. Repair, replace and adjust disc brake components

D. Diagnose and Repair Power Assist Brakes

1. Diagnose and determine needed repairs on power-assist brakes
2. Repair or replace power brake components
3. Repair or replace hydra-boost components
4. Check operation of anti-skid braking systems, adjust or repair according to manufacturers recommendations

ELECTRICAL SYSTEMS

A. General Electrical System Diagnosis

1. Check continuity in electrical circuits using test light and voltmeter
2. Check for shorts, opens and grouts

3. Measure resistance in electrical circuits using an ohmmeter
4. Measure volts with a voltmeter
5. Measure currect with an ammeter

B. Battery Diagnosis and Service

1. Clean and inspect battery clamps, cables and connectors
2. Perform battery condition tests
3. Jump start a vehicle
4. Charge and install a battery

C. Starting System Diagnosis and Repair

1. Diagnose starting system and determine needed repair
2. Remove, clean and inspect starter motor
3. Repair or replace starter motor components

D. Charging System Diagnosis and Repair

1. Diagnose charging system and determine needed repairs
2. Remove, clean and inspect alternator
3. Repair or replace alternator components
4. Repair or replace charging system components

E. Lighting System Diagnosis and Repair

1. Diagnose lighting system problems and determine needed repairs
2. Repair or replace lights, sockets, wires and switches

F. Gauges and Electrical Accessories

1. Diagnose and repair gauge and warning circuits
2. Diagnose and repair electrical accessories (horn, wiper, motor)

HEATING AND AIR CONDITIONING

A. Air Conditioning

1. Diagnose and performance test A/C systems for problems and determine needed repairs
2. Clean, inspect and repair A/C system components
3. Evacuate and charge A/C system and performance test
4. Diagnose and repair electrical temperature control units

B. Heating System

1. Diagnose and repair heating system problems and determine needed repairs
2. Inspect and replace heating system components

ENGINE PERFORMANCE

A. Ignition System

1. Conduct engine performance test using engine analyzer and determine needed repairs
2. Inspect, repair or replace primary ignition components
3. Inspect, repair or replace secondary ignition components
4. Adjust ignition system to manufacturers specifications
5. Perform on-board computer system diagnosis
6. Repair or replace computer system components

B. Fuel and Exhaust Systems

1. Diagnose fuel system problems and determine needed repairs
2. Inspect, repair or replace fuel supply component
3. Disassemble, clean and inspect carburetors
4. Reassemble and adjust carburetors
5. Disassemble, clean and inspect fuel injection components
6. Repair or replace fuel injection components
7. Adjust fuel systems (injection and carburetion)
8. Diagnose and repair exhaust system problems

C. Emission Control Systems

1. Diagnose emission control systems and determine needed repairs
2. Clean, inspect/replace PCV system components
3. Clean, inspect/replace spark timing controllers
4. Clean, inspect/replace idle speed controllers
5. Clean, inspect/replace exhaust gas recirculation
6. Clean, inspect/replace air management system
7. Clean, inspect/replace inlet air temperature control
8. Clean, inspect/replace intake manifold heat controls
9. Clean, inspect/replace fuel vapor controls

AUTO MECHANICS
ACCESS SKILLS CHECKLIST

Student Name/ID ______________________ Sending School ______________________

Instructor ______________________ Date(s) Evaluated ______________________

Circle proper mastery code: 3 = MASTERY 2 = REQUIRES SUPERVISION
1 = NOT MASTERED N or blank = NO EXPOSURE

TASK DESCRIPTION	TASK ID #	MASTERY CODE	MASTERY DATE	RETRY CODE/DATE
1. Count two-place numbers	470698A001	3 2 1 N		
2. Add two-place numbers	470698A002	3 2 1 N		
3. Subtract two-place numbers	470698A003	3 2 1 N		
4. Perform standard units of measurement, i.e., cup, pint, quart, inch, foot, yard, ounce, pound	470698A004	3 2 1 N		
5. Use basic measuring instruments, i.e., rulers, scales	470698A005	3 2 1 N		
6. Multiply two-place numbers	470698A006	3 2 1 N		
7. Divide two-place numbers	470698A007	3 2 1 N		
8. Add common fractions	470698A008	3 2 1 N		
9. Subtract common fractions	470698A009	3 2 1 N		
10. Multiply common fractions	470698A010	3 2 1 N		
11. Divide common fractions	470698A011	3 2 1 N		
12. Add two-place decimals	470698A012	3 2 1 N		
13. Subtract two-place decimals	470698A013	3 2 1 N		
14. Multiply two-place decimals	470698A014	3 2 1 N		
15. Divide two-place decimals	470698A015	3 2 1 N		
16. Lift 50 lbs. maximum with frequent lifting and/or carrying of objects weighing up to 25 lbs. (Medium work)	470698B001	3 2 1 N		
17. Bend body downward and forward by bending the spine at the waist (stooping)	470698B002	3 2 1 N		
18. Bend legs at the knees to come to rest on the knee or knees (kneeling)	470698B003	3 2 1 N		
19. Bend body downward and forward by bending the legs and spine (crouching)	470698B004	3 2 1 N		
20. Move about on the hands and knees or hands and feet (crawling)	470698B005	3 2 1 N		
21. Extend the hands and arms in any direction (reaching)	470698B006	3 2 1 N		
22. Seize, hold, grasp, turn or otherwise work with the hand or hands (handling)	470698B007	3 2 1 N		
23. Pick, pinch, or otherwise work with the fingers (fingering)	470698B008	3 2 1 N		

AUTO MECHANICS
ACCESS SKILLS CHECKLIST

Student Name/ID ____________________ Sending School ____________________

Instructor ____________________ Date(s) Evaluated ____________________

Circle proper mastery code: 3 = MASTERY 2 = REQUIRES SUPERVISION
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TASK DESCRIPTION	TASK ID #	MASTERY CODE	MASTERY DATE	RETRY CODE/DATE
24. Perceive size, shape, temperature or texture of objects and materials by using fingertips (feeling)	470698B009	3 2 1 N		
25. Ability to work inside	470698B010	3 2 1 N		
26. Ability to work in extreme noise, constant or intermittent, causing marked distraction or possibly injury to hearing	470698B011	3 2 1 N		
27. Ability to work in extreme vibration, i.e., strain on body or extremities from repeated motion or shock	470698B012	3 2 1 N		
28. Ability to work in hazardous conditions, i.e., fumes, odors, toxic conditions, dust and poor ventilation	470698B013	3 2 1 N		
29. Think visually of geometric forms (S-spatial)	470698C001	3 2 1 N		
30. Comprehend the two dimensional representation of three-dimensional objects (S-spatial)	470698C002	3 2 1 N		
31. Recognize the relationship resulting from the movements of objects in space (S-spatial)	470698C003	3 2 1 N		
32. Perceive pertinent detail in objects in pictorial or graphic material (P-form perception)	470698C004	3 2 1 N		
33. Make visual comparisons and discriminations and see slight differences (P-form perception)	470698C005	3 2 1 N		
34. Move the hands easily and skillfully (M-manual dexterity)	470698C006	3 2 1 N		
35. Work with the hands in placing and turning motions (M-manual dexterity)	470698C007	3 2 1 N		
36. Making generalizations, evaluations, or decisions based on measurable or verifiable criteria	470698D001	3 2 1 N		
37. Situations requiring the precise attainment of set limits, tolerances, or standards	470698D002	3 2 1 N		
38. Performing a variety of duties, often changing from one task to another of a different nature without loss of efficiency or composure	470698D003	3 2 1 N		

AUTO MECHANICS
ACCESS SKILLS CHECKLIST

Student Name/ID ______________________ Sending School ______________________

Instructor ______________________ Date(s) Evaluated ______________________

Circle proper mastery code: 3 = MASTERY 2 = REQUIRES SUPERVISION
1 = NOT MASTERED N or blank = NO EXPOSURE

TASK DESCRIPTION	TASK ID #	MASTERY CODE	MASTERY DATE	RETRY CODE/DATE
39. Identify basic hand tools and equipment	470698E001	3 2 1 N	________	________
40. Use basic hand tools and equipment	470698E002	3 2 1 N	________	________
41. Demonstrate knowledge of basic safety concepts	470698E003	3 2 1 N	________	________

AUTO MECHANICS VOCABULARY LIST

AUTOMOBILE BODY	encloses the engine and people in the car
BRAKES	consists of master cylinder, brake drums and shoes, brake pedal and calipers
CHASSIS	the metal frame that supports the body, engine and tires
COOLING SYSTEM	consists of the radiator, fan, pump and antifreeze system
CYLINDER BLOCK	largest part of engine in which the cylinders are placed
ELECTRICAL SYSTEM	consists of the battery, starter, generator, regulator, distributor, ignition system and light system
ENGINE	produces power to move the car
EXHAUST PIPE	pipe connecting the engine to the muffler
FILTER	a unit containing an element, such as a screen. This screen keeps foreign particles from entering the clean fluid
FUEL SYSTEM	consists of the carburetor, air filter, fuel pump and fuel lines
GENERATOR	device which generates electricity
MUFFLER	a chamber attached to the end of the exhaust pipe which allows the exhaust gases to expand and cool
ODOMETER	measures and registers the number of miles traveled
POLARITY	refers to the positive or negative terminal of a battery or an electrical circuit
P.S.I.	a measurement of pressure in pounds per square inch
REFRIGERANT	material used in the circulation system of a refrigerator which absorbs and conveys heat
REGULATOR	an automatic pressure reducing or regulating value
SQ. FT.	square feet
SQ. IN.	square inch
TIE ROD	the rod which connects the steering spindle arms on opposite sides of the vehicle
VOLTS	a unit of electrical force which causes a current of one ampere to flow through a resistance of one ohm

TOOL LIST FOR AUTO MECHANICS

Bubble balance

Feeler gauge

Files

Fuse puller

Galvanometer

Grease gun

Hacksaw

Hammer

Hydraulic lift

Jack stands

Jumper cable

Lug wrench

Micrometer

Oil filter wrench

Oscilloscope

Pliers

Pry bar

Screwdriver

Stroboscope

Tachometer

Test light

Tire pressure gauge

Torque wrench

Voltmeter

Wheel weight

Weight hammer

Wrench

AUTO MECHANICS

Math Skills

Count two-place numbers
Add two-place numbers
Subtract two-place numbers
Perform standard units of measurement, i.e., cup, pint, quart, inch, foot, yard, ounce, pound
Use basic measuring instruments, i.e., rulers, scales
Multiply two-place numbers
Divide two-place numbers
Add common fractions
Subtract common fractions
Multiply common fractions
Divide common fractions
Add two-place decimals
Subtract two-place decimals
Multiply two-place decimals
Divide two-place decimals

NOTE: Many math books and workbooks provide needed direction in learning basic operations in math. This section assumes that students have basic skills and is designed to be used in conjunction with any of the math books you might be using, or to establish your own supplemental units. Any math practice activities should be developed within the context of the vocational program. Other persons to use as resources in this area include: parents, math teacher, and industrial arts teacher.

1. While completing the activities on the following pages, the student will practice all of the above skills. Give students Worksheets and tax table (acquired by the teacher. An old chart is included for convenience, but a current table would be better to use.).

   Answers

   Inventory Worksheet AM #1:

   1. 53 quarts
   2. 8 boxes
   3. 0
   4. 10
   5. 27 ft.
   6. 0
   7. 28
   8. 102
   9. 11.5
   10. 20

   Charges Worksheet AM #2:

   Grand Total $311.00

   Operating Expenses Worksheet AM #3:

   1. $1,071.00
   2. $3.50
   3. $4.50
   4. $49.95
   5. $3.70
   6. 60 qts/ $90.00
   7. 6 filters/ $14.40
   8. $75.00
   9. $ 1, 391.55

Completing Work Orders Worksheet AM #4

- Answers on Teacher Work Order

Measurement Units Worksheet AM #5:

1. 2 tons
2. 5 tonnes
3. 6 gallons
4. 1436.5 lbs.
5. 4 lbs.
6. 2200 lbs.
7. 1 kg.
8. 2 quarts
9. 1/2 quart
10. 2 oz.

Measurement Instruments Worksheet AM #6:

1. 71 3/5
2. 35
3. 10 4/10
4. 2.5 (2 1/2)
5. 10 3/4
6. 15 8/10
7. 19 2/8
8. 16 1/2
9. 68
10. 9 1/4

WORKSHEET

INVENTORY

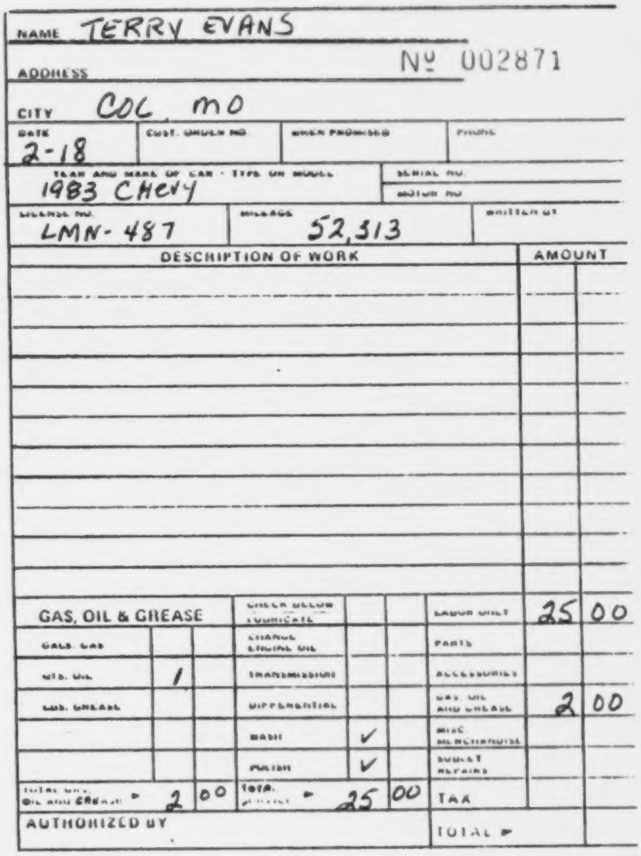
DIRECTIONS: Using the chart below, figure out how much of each item needs to be ordered. Put your answer on the blank line in each row.

ITEM	# NEEDED	# ON SHELF (stock)	# TO ORDER
1. Oil	65 quarts	12 quarts	________
2. Washers	10 boxes	2 boxes	________
3. Body Putty	100 pounds	150 pounds	________
4. Spark Plugs	25	15	________
5. Ignition Wire	50 feet	23 feet	________
6. Trim Clips	50	50	________
7. Pop Rivets	100	72	________
8. Heater hose	300 feet	198 feet	________
9. Copper tubing	15.0 feet	3.5 feet	________
10. Antifreeze	30 quarts	10 quarts	________

AM #2

WORKSHEET

DIRECTIONS: Add up all the charges on each of the tickets below, then add up the grand total (all added together). Put the grand total at the bottom.

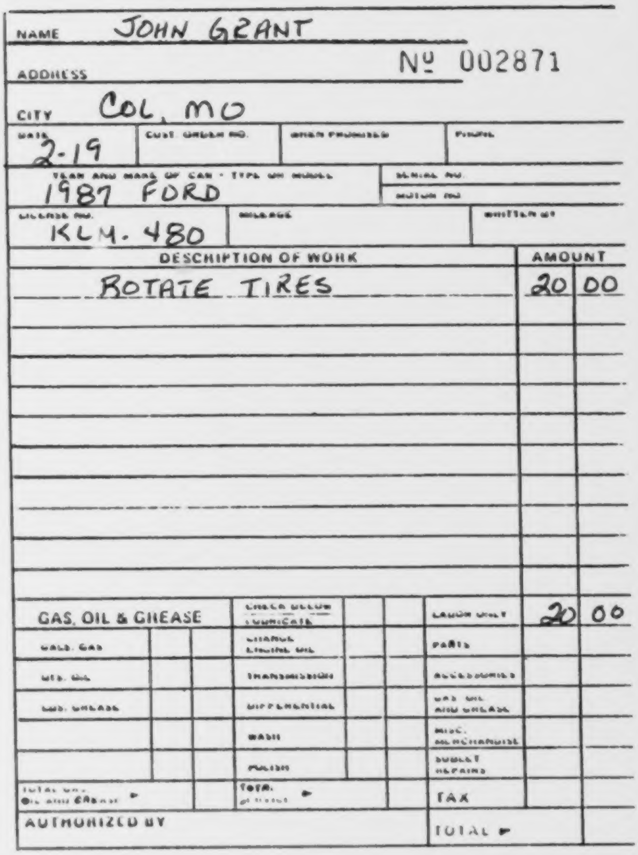


NAME TERRY EVANS
ADDRESS
№ 002871
CITY COL. MO
DATE 2-18
CUST. ORDER NO.
WHEN PROMISED
PHONE
YEAR AND MAKE OF CAR - TYPE OR MODEL 1983 CHEVY
SERIAL NO.
MOTOR NO.
LICENSE NO. LMN-487
MILEAGE 52,313
WRITTEN BY

DESCRIPTION OF WORK	AMOUNT	

GAS, OIL & GREASE			CHECK BELOW LUBRICATE			LABOR ONLY	25	00
GALS. GAS			CHANGE ENGINE OIL			PARTS		
QTS. OIL	1		TRANSMISSION			ACCESSORIES		
LBS. GREASE			DIFFERENTIAL			GAS, OIL AND GREASE	2	00
			WASH	✓		MISC. MERCHANDISE		
			POLISH	✓		SUBLET REPAIRS		
TOTAL GAS, OIL AND GREASE ►	2	00	TOTAL [illegible] ►	25	00	TAX		

AUTHORIZED BY
TOTAL ►



NAME JOHN GRANT
ADDRESS
№ 002871
CITY COL. MO
DATE 2-19
CUST. ORDER NO.
WHEN PROMISED
PHONE
YEAR AND MAKE OF CAR - TYPE OR MODEL 1987 FORD
SERIAL NO.
MOTOR NO.
LICENSE NO. KLM. 480
MILEAGE
WRITTEN BY

DESCRIPTION OF WORK	AMOUNT	
ROTATE TIRES	20	00

GAS, OIL & GREASE			CHECK BELOW LUBRICATE			LABOR ONLY	20	00
GALS. GAS			CHANGE ENGINE OIL			PARTS		
QTS. OIL			TRANSMISSION			ACCESSORIES		
LBS. GREASE			DIFFERENTIAL			GAS, OIL AND GREASE		
			WASH			MISC. MERCHANDISE		
			POLISH			SUBLET REPAIRS		
TOTAL GAS, OIL AND GREASE ►			TOTAL [illegible] ►			TAX		

AUTHORIZED BY
TOTAL ►

AM #2 (continued)

NAME MARY SMITH

ADDRESS Nº 002871

CITY COL, MO

DATE 2-19

YEAR AND MAKE OF CAR - TYPE OR MODEL 1979 CHEVY MALIBU

DESCRIPTION OF WORK	AMOUNT	
Change tires ②	150	00
Check BRAKES	15	00
TUNE UP	50	00

GAS, OIL & GREASE							
GALS. GAS			CHANGE ENGINE OIL			PARTS	
QTS. OIL			TRANSMISSION			ACCESSORIES	
LBS. GREASE			DIFFERENTIAL			GAS, OIL AND GREASE	
			WASH			MISC. MERCHANDISE	
			POLISH			SUBLET REPAIRS	
TOTAL GAS, OIL AND GREASE ▶			TOTAL ▶			TAX	

AUTHORIZED BY

TOTAL ▶

NAME ED TIPTON

ADDRESS Nº 002871

CITY COL, MO

DATE 2-18

YEAR AND MAKE OF CAR - TYPE OR MODEL 1982 FORD PICKUP

DESCRIPTION OF WORK	AMOUNT

GAS, OIL & GREASE						LABOR ONLY	35 00
GALS. GAS	10.	00	CHANGE ENGINE OIL	10	00	PARTS	
QTS. OIL	4		TRANSMISSION			ACCESSORIES	
LBS. GREASE			DIFFERENTIAL			GAS, OIL AND GREASE	14 00
			WASH	✓		MISC. MERCHANDISE	
			POLISH	✓		SUBLET REPAIRS	
TOTAL GAS, OIL AND GREASE ▶	14	00	TOTAL ▶	35	00	TAX	

AUTHORIZED BY

TOTAL ▶

GRAND TOTAL OF ALL CHARGES $ ____________

AM #3

WORKSHEET

You have kept a record of your car's operating expenses during the year. What was the total operating cost?

Item	Amount Used	Cost (per unit)	Cost (each item)
1. Gasoline	900 gallons	1.19 per gal.	
2. Transmission Fluid	2 quarts	1.75 per quart	
3. Power Steering Belt	1 belt	4.50 each	
4. Lube Job	5 lube jobs	9.99 each	
5. Differential Lube	2 pints	1.85 per pint	
Oil change 6. 5 qt. with filter change	12 oil changes _____ quarts	1.50 per quart	
Oil filter 7. Every second oil change	12 oil changes _____ filters	2.40	
8. Tire Wear		75.00	
Miscellaneous Repair 9. Charges		239.60	
		Total Cost	

WORKSHEET

COMPLETING WORK ORDERS

DIRECTIONS: Complete the two work order forms. Add in the sales tax, using the table provided.

Work Order # 1

1. James Rogers
2. 3874 Loggin St., Columbia, MO
3. 445-1234
4. Today's Date
5. 1979 Chevy Malibu V-6
6. License Plate KER 849
7. Mileage 65,392
8. Oil change - 5 quarts
9. Penzoil 10W-40 at $1.49 per quart
10. Filter change ($8.00)

Work Order # 2

1. Robert Johnson
2. 1814 Rosecliff Dr., Columbia, MO
3. 874-3209
4. Today's Date
5. 1981 Camaro
6. License Plate - MKL 608
7. Mileage - 32,140
8. Rebuild both wheel cylinders ($40.00)
9. Replace brake hose - front ($13.50)
10. Rebuild master cylinder (16.00)

AM#4

WORK ORDER # 1

AUTO MECHANICS
COLUMBIA, MO. 65201

NAME
ADDRESS
№ 002871
CITY

DATE	CUST. ORDER NO.	WHEN PROMISED	PHONE

YEAR AND MAKE OF CAR - TYPE OR MODEL	SERIAL NO.
	MOTOR NO.

LICENSE NO.	MILEAGE	WRITTEN BY

AMT.	PART No.	NAME OF PART	SALE AMT.
	TOTAL PARTS ►		

DESCRIPTION OF WORK	AMOUNT

GAS, OIL & GREASE			CHECK BELOW					
			LUBRICATE			LABOR ONLY	90	00
GALS. GAS			CHANGE ENGINE OIL			PARTS		
QTS. OIL			TRANSMISSION			ACCESSORIES		
LBS. GREASE	3	20	DIFFERENTIAL			GAS, OIL AND GREASE		
			WASH			MISC. MERCHANDISE		
			POLISH			SUBLET REPAIRS		
TOTAL GAS, OIL AND GREASE ►			TOTAL SERVICE ►			TAX		

ACCESSORIES – TIRES AND TUBES

TOTAL ACCESSORIES ►		

AUTHORIZED BY

TOTAL ►

ESTIMATES ARE FOR LABOR ONLY, MATERIAL ADDITIONAL

I hereby authorize the above repair work to be done along with necessary materials. You and your employees may operate above vehicle for purposes of testing, inspection or delivery at my risk. An express mechanic's lien is acknowledged on above vehicle to secure the amount of repairs thereto. It is understood that this company assumes no responsibility for loss or damage by theft or fire to vehicles placed with them for storage, sale, repair or while road testing.

PAY THIS AMOUNT ↑

AM#4

WORK ORDER # 2

AUTO MECHANICS
COLUMBIA, MO. 65201

NAME
ADDRESS
CITY

№ 002871

DATE	CUST. ORDER NO.	WHEN PROMISED	PHONE

YEAR AND MAKE OF CAR - TYPE OR MODEL	SERIAL NO. MOTOR NO.

LICENSE NO.	MILEAGE	WRITTEN BY

AMT.	PART No.	NAME OF PART	SALE AMT.	
TOTAL PARTS ►				

ACCESSORIES – TIRES AND TUBES

TOTAL ACCESSORIES ►			

DESCRIPTION OF WORK	AMOUNT	

GAS, OIL & GREASE			CHECK BELOW LUBRICATE			LABOR ONLY	190	00
GALS. GAS			CHANGE ENGINE OIL			PARTS		
QTS. OIL			TRANSMISSION			ACCESSORIES		
LUB. GREASE			DIFFERENTIAL			GAS, OIL AND GREASE		
			WASH			MISC. MERCHANDISE		
			POLISH			SUBLET REPAIRS		
TOTAL GAS, OIL AND GREASE ►			TOTAL SERVICE ►			TAX		
AUTHORIZED BY						TOTAL ►		

ESTIMATES ARE FOR LABOR ONLY, MATERIAL ADDITIONAL

I hereby authorize the above repair work to be done along with necessary materials. You and your employees may operate above vehicle for purposes of testing, inspection or delivery at my risk. An express mechanic's lien is acknowledged on above vehicle to secure the amount of repairs thereto. It is understood that the company assumes no responsibility for loss or damage by theft or fire to vehicles placed with them for storage, sale, repair or while road testing.

PAY THIS AMOUNT ↑

6⅛%
4% State
⅛% Conservation
%Local Taxes

OPTIONAL
MISSOURI SALES/USE TAX FORMULA

6⅛%
4% State
⅛% Conservation
2%Local Taxes

MISSOURI DEPARTMENT OF REVENUE
JANUARY 1983

Sale	Tax	Sale	Tax	Sale	Tax	Sale	Tax
$ .00- .08	$.00	12.00-12.16	.74	24.09-24.24	1.48	36.17-36.32	2.22
.09- .24	.01	12.17-12.32	.75	24.25-24.40	1.49	36.33-36.48	2.23
.25- .40	.02	12.33-12.48	.76	24.41-24.57	1.50	36.49-36.65	2.24
.41- .57	.03	12.49-12.65	.77	24.58-24.73	1.51	36.66-36.81	2.25
.58- .73	.04	12.66-12.81	.78	24.74-24.89	1.52	36.82-36.97	2.26
.74- .89	.05	12.82-12.97	.79	24.90-25.06	1.53	36.98-37.14	2.27
.90- 1.06	.06	12.98-13.14	.80	25.07-25.22	1.54	37.15-37.30	2.28
1.07- 1.22	.07	13.15-13.30	.81	25.23-25.38	1.55	37.31-37.46	2.29
1.23- 1.38	.08	13.31-13.46	.82	25.39-25.55	1.56	37.47-37.63	2.30
1.39- 1.55	.09	13.47-13.63	.83	25.56-25.71	1.57	37.64-37.79	2.31
1.56- 1.71	.10	13.64-13.79	.84	25.72-25.87	1.58	37.80-37.95	2.32
1.72- 1.87	.11	13.80-13.95	.85	25.88-26.04	1.59	37.96-38.12	2.33
1.88- 2.04	.12	13.96-14.12	.86	26.05-26.20	1.60	38.13-38.28	2.34
2.05- 2.20	.13	14.13-14.28	.87	26.21-26.36	1.61	38.29-38.44	2.35
2.21- 2.36	.14	14.29-14.44	.88	26.37-26.53	1.62	38.45-38.61	2.36
2.37- 2.53	.15	14.45-14.61	.89	26.54-26.69	1.63	38.62-38.77	2.37
2.54- 2.69	.16	14.62-14.77	.90	26.70-26.85	1.64	38.78-38.93	2.38
2.70- 2.85	.17	14.78-14.93	.91	26.86-27.02	1.65	38.94-39.10	2.39
2.86- 3.02	.18	14.94-15.10	.92	27.03-27.18	1.66	39.11-39.26	2.40
3.03- 3.18	.19	15.11-15.26	.93	27.19-27.34	1.67	39.27-39.42	2.41
3.19- 3.34	.20	15.27-15.42	.94	27.35-27.51	1.68	39.43-39.59	2.42
3.35- 3.51	.21	15.43-15.59	.95	27.52-27.67	1.69	39.60-39.75	2.43
3.52- 3.67	.22	15.60-15.75	.96	27.68-27.83	1.70	39.76-39.91	2.44
3.68- 3.83	.23	15.76-15.91	.97	27.84-27.99	1.71	39.92-40.08	2.45
3.84- 3.99	.24	15.92-16.08	.98	28.00-28.16	1.72	40.09-40.24	2.46
4.00- 4.16	.25	16.09-16.24	.99	28.17-28.32	1.73	40.25-40.40	2.47
4.17- 4.32	.26	16.25-16.40	1.00	28.33-28.48	1.74	40.41-40.57	2.48
4.33- 4.48	.27	16.41-16.57	1.01	28.49-28.65	1.75	40.58-40.73	2.49
4.49- 4.65	.28	16.58-16.73	1.02	28.66-28.81	1.76	40.74-40.89	2.50
4.66- 4.81	.29	16.74-16.89	1.03	28.82-28.97	1.77	40.90-41.06	2.51
4.82- 4.97	.30	16.90-17.06	1.04	28.98-29.14	1.78	41.07-41.22	2.52
4.98- 5.14	.31	17.07-17.22	1.05	29.15-29.30	1.79	41.23-41.38	2.53
5.15- 5.30	.32	17.23-17.38	1.06	29.31-29.46	1.80	41.39-41.55	2.54
5.31- 5.46	.33	17.39-17.55	1.07	29.47-29.63	1.81	41.56-41.71	2.55
5.47- 5.63	.34	17.56-17.71	1.08	29.64-29.79	1.82	41.72-41.87	2.56
5.64- 5.79	.35	17.72-17.87	1.09	29.80-29.95	1.83	41.88-42.04	2.57
5.80- 5.95	.36	17.88-18.04	1.10	29.96-30.12	1.84	42.05-42.20	2.58
5.96- 6.12	.37	18.05-18.20	1.11	30.13-30.28	1.85	42.21-42.36	2.59
6.13- 6.28	.38	18.21-18.36	1.12	30.29-30.44	1.86	42.37-42.53	2.60
6.29- 6.44	.39	18.37-18.53	1.13	30.45-30.61	1.87	42.54-42.69	2.61
6.45- 6.61	.40	18.54-18.69	1.14	30.62-30.77	1.88	42.70-42.85	2.62
6.62- 6.77	.41	18.70-18.85	1.15	30.78-30.93	1.89	42.86-43.02	2.63
6.78- 6.93	.42	18.86-19.02	1.16	30.94-31.10	1.90	43.03-43.18	2.64
6.94- 7.10	.43	19.03-19.18	1.17	31.11-31.26	1.91	43.19-43.34	2.65
7.11- 7.26	.44	19.19-19.34	1.18	31.27-31.42	1.92	43.35-43.51	2.66
7.27- 7.42	.45	19.35-19.51	1.19	31.43-31.59	1.93	43.52-43.67	2.67
7.43- 7.59	.46	19.52-19.67	1.20	31.60-31.75	1.94	43.68-43.83	2.68
7.60- 7.75	.47	19.68-19.83	1.21	31.76-31.91	1.95	43.84-43.99	2.69
7.76- 7.91	.48	19.84-19.99	1.22	31.92-32.08	1.96	44.00-44.16	2.70
7.92- 8.08	.49	20.00-20.16	1.23	32.09-32.24	1.97	44.17-44.32	2.71
8.09- 8.24	.50	20.17-20.32	1.24	32.25-32.40	1.98	44.33-44.48	2.72
8.25- 8.40	.51	20.33-20.48	1.25	32.41-32.57	1.99	44.49-44.65	2.73
8.41- 8.57	.52	20.49-20.65	1.26	32.58-32.73	2.00	44.66-44.81	2.74
8.58- 8.73	.53	20.66-20.81	1.27	32.74-32.89	2.01	44.82-44.97	2.75
8.74- 8.89	.54	20.82-20.97	1.28	32.90-33.06	2.02	44.98-45.14	2.76
8.90- 9.06	.55	20.98-21.14	1.29	33.07-33.22	2.03	45.15-45.30	2.77
9.07- 9.22	.56	21.15-21.30	1.30	33.23-33.38	2.04	45.31-45.46	2.78
9.23- 9.38	.57	21.31-21.46	1.31	33.39-33.55	2.05	45.47-45.63	2.79
9.39- 9.55	.58	21.47-21.63	1.32	33.56-33.71	2.06	45.64-45.79	2.80
9.56- 9.71	.59	21.64-21.79	1.33	33.72-33.87	2.07	45.80-45.95	2.81
9.72- 9.87	.60	21.80-21.95	1.34	33.88-34.04	2.08	45.96-46.12	2.82
9.88-10.04	.61	21.96-22.12	1.35	34.05-34.20	2.09	46.13-46.28	2.83
10.05-10.20	.62	22.13-22.28	1.36	34.21-34.36	2.10	46.29-46.44	2.84
10.21-10.36	.63	22.29-22.44	1.37	34.37-34.53	2.11	46.45-46.61	2.85
10.37-10.53	.64	22.45-22.61	1.38	34.54-34.69	2.12	46.62-46.77	2.86
10.54-10.69	.65	22.62-22.77	1.39	34.70-34.85	2.13	46.78-46.93	2.87
10.70-10.85	.66	22.78-22.93	1.40	34.86-35.02	2.14	46.94-47.10	2.88
10.86-11.02	.67	22.94-23.10	1.41	35.03-35.18	2.15	47.11-47.26	2.89
11.03-11.18	.68	23.11-23.26	1.42	35.19-35.34	2.16	47.27-47.42	2.90
11.19-11.34	.69	23.27-23.42	1.43	35.35-35.51	2.17	47.43-47.59	2.91
11.35-11.51	.70	23.43-23.59	1.44	35.52-35.67	2.18	47.60-47.75	2.92
11.52-11.67	.71	23.60-23.75	1.45	35.68-35.83	2.19	47.76-47.91	2.93
11.68-11.83	.72	23.76-23.91	1.46	35.84-35.99	2.20	47.92-48.08	2.94
11.84-11.99	.73	23.92-24.08	1.47	36.00-36.16	2.21	48.09-48.24	2.95

DOR-1900H (1-83)

6⅛% OPTIONAL MISSOURI SALES/USE TAX FORMULA

Sale	Tax	Sale	Tax	Sale	Tax	Sale	Tax
48.25-48.40	2.96	61.31-61.46	3.76	74.37-74.53	4.56	87.43-87.59	5.36
48.41-48.57	2.97	61.47-61.63	3.77	74.54-74.69	4.57	87.60-87.75	5.37
48.58-48.73	2.98	61.64-61.79	3.78	74.70-74.85	4.58	87.76-87.91	5.38
48.74-48.89	2.99	61.80-6195	3.79	74.86-75.02	4.59	87.92-88.08	5.39
48.90-49.06	3.00	61.96-62.12	3.80	75.03-75.18	4.60	88.09-88.24	5.40
49.07-49.22	3.01	62.13-62.28	3.81	75.19-75.34	4.61	88.25-88.40	5.41
49.23-49.38	3.02	62.29-62.44	3.82	75.35-75.51	4.62	88.41-88.57	5.42
49.39-49.55	3.03	62.45-62.61	3.83	75.52-75.67	4.63	88.58-88.73	5.43
49.56-49.71	3.04	62.62-62.77	3.84	75.68-75.83	4.64	88.74-88.89	5.44
49.72-49.87	3.05	62.78-62.93	3.85	75.84-75.99	4.65	88.90-89.06	5.45
49.88-50.04	3.06	62.94-63.10	3.86	76.00-76.16	4.66	89.07-89.22	5.46
50.05-50.20	3.07	63.11-63.26	3.87	76.17-76.32	4.67	89.23-89.38	5.47
50.21-50.36	3.08	63.27-63.42	3.88	76.33-76.48	4.68	89.39-89.55	5.48
50.37-50.53	3.09	63.43-63.59	3.89	76.49-76.65	4.69	89.56-89.71	5.49
50.54-50.69	3.10	63.60-63.75	3.90	76.66-76.81	4.70	89.72-89.87	5.50
50.70-50.85	3.11	63.76-63.91	3.91	76.82-76.97	4.71	89.88-90.04	5.51
50.86-51.02	3.12	63.92-64.08	3.92	76.98-77.14	4.72	90.05-90.20	5.52
51.03-51.18	3.13	64.09-64.24	3.93	77.15-77.30	4.73	90.21-90.36	5.53
51.19-51.34	3.14	64.25-64.40	3.94	77.31-77.46	4.74	90.37-90.53	5.54
51.35-51.51	3.15	64.41-64.57	3.95	77.47-77.63	4.75	90.54-90.69	5.55
51.52-51.67	3.16	64.58-64.73	3.96	77.64-77.79	4.76	90.70-90.85	5.56
51.68-51.83	3.17	64.74-64.89	3.97	77.80-77.95	4.77	90.86-91.02	5.57
51.84-51.99	3.18	64.90-65.06	3.98	77.96-78.12	4.78	91.03-91.18	5.58
52.00-52.16	3.19	65.07-65.22	3.99	78.13-78.28	4.79	91.19-91.34	5.59
52.17-52.32	3.20	65.23-65.38	4.00	78.29-78.44	4.80	91.35-91.51	5.60
52.33-52.48	3.21	65.39-65.55	4.01	78.45-78.61	4.81	91.52-91.67	5.61
52.49-52.65	3.22	65.56-65.71	4.02	78.62-78.77	4.82	91.68-91.83	5.62
52.66-52.81	3.23	65.72-65.87	4.03	78.78-78.93	4.83	91.84-91.99	5.63
52.82-52.97	3.24	65.88-66.04	4.04	78.94-79.10	4.84	92.00-92.16	5.64
52.98-53.14	3.25	66.05-66.20	4.05	79.11-79.26	4.85	92.17-92.32	5.65
53.15-53.30	3.26	66.21-66.36	4.06	79.27-79.42	4.86	92.33-92.48	5.66
53.31-53.46	3.27	66.37-66.53	4.07	79.43-79.59	4.87	92.49-92.65	5.67
53.47-53.63	3.28	66.54-66.69	4.08	79.60-79.75	4.88	92.66-92.81	5.68
53.64-53.79	3.29	66.70-66.85	4.09	79.76-79.91	4.89	92.82-92.97	5.69
53.80-53.95	3.30	66.86-67.02	4.10	79.92-80.08	4.90	92.98-93.14	5.70
53.96-54.12	3.31	67.03-67.18	4.11	80.09-80.24	4.91	93.15-93.30	5.71
54.13-54.28	3.32	67.19-67.34	4.12	80.25-80.40	4.92	93.31-93.46	5.72
54.29-54.44	3.33	67.35-67.51	4.13	80.41-80.57	4.93	93.47-93.63	5.73
54.45-54.61	3.34	67.52-67.67	4.14	80.58-80.73	4.94	93.64-93.79	5.74
54.62-54.77	3.35	67.68-67.83	4.15	80.74-80.89	4.95	93.80-93.95	5.75
54.78-54.93	3.36	67.84-67.99	4.16	80.90-81.06	4.96	93.96-94.12	5.76
54.94-55.10	3.37	68.00-68.16	4.17	81.07-81.22	4.97	94.13-94.28	5.77
55.11-55.26	3.38	68.17-68.32	4.18	81.23-81.38	4.98	94.29-94.44	5.78
55.27-55.42	3.39	68.33-68.48	4.19	81.39-81.55	4.99	94.45-94.61	5.79
55.43-55.59	3.40	68.49-68.65	4.20	81.56-81.71	5.00	94.62-94.77	5.80
55.60-55.75	3.41	68.66-68.81	4.21	81.72-81.87	5.01	94.78-94.93	5.81
55.76-55.91	3.42	68.82-68.97	4.22	81.88-82.04	5.02	94.94-95.10	5.82
55.92-56.08	3.43	68.98-69.14	4.23	82.05-82.20	5.03	95.11-95.26	5.83
56.09-56.24	3.44	69.15-69.30	4.24	82.21-82.36	5.04	95.27-95.42	5.84
56.25-56.40	3.45	69.31-69.46	4.25	82.37-82.53	5.05	95.43-95.59	5.85
56.41-56.57	3.46	69.47-69.63	4.26	82.54-82.69	5.06	95.60-95.75	5.86
56.58-56.73	3.47	69.64-69.79	4.27	82.70-82.85	5.07	95.76-95.91	5.87
56.74-56.89	3.48	69.80-69.95	4.28	82.86-83.02	5.08	95.92-96.08	5.88
56.90-57.06	3.49	69.96-70.12	4.29	83.03-83.18	5.09	96.09-96.24	5.89
57.07-57.22	3.50	70.13-70.28	4.30	83.19-83.34	5.10	96.25-96.40	5.90
57.23-57.38	3.51	70.29-70.44	4.31	83.35-83.51	5.11	96.41-96.57	5.91
57.39-57.55	3.52	70.45-70.61	4.32	83.52-83.67	5.12	96.58-96.73	5.92
57.56-57.71	3.53	70.62-70.77	4.33	83.68-83.83	5.13	96.74-96.89	5.93
57.72-57.87	3.54	70.78-70.93	4.34	83.84-83.99	5.14	96.90-97.06	5.94
57.88-58.04	3.55	70.94-71.10	4.35	84.00-84.16	5.15	97.07-97.22	5.95
58.05-58.20	3.56	71.11-71.26	4.36	84.17-84.32	5.16	97.23-97.38	5.96
58.21-58.36	3.57	71.27-71.42	4.37	84.33-84.48	5.17	97.39-97.55	5.97
58.37-58.53	3.58	71.43-71.59	4.38	84.49-84.65	5.18	97.56-97.71	5.98
58.54-58.69	3.59	71.60-71.75	4.39	84.66-84.81	5.19	97.72-97.87	5.99
58.70-58.85	3.60	71.76-71.91	4.40	84.82-84.97	5.20	97.88-98.04	6.00
58.86-59.02	3.61	71.92-72.08	4.41	84.98-85.14	5.21	98.05-98.20	6.01
59.03-59.18	3.62	72.09-72.24	4.42	85.15-85.30	5.22	98.21-98.36	6.02
59.19-59.34	3.63	72.25-72.40	4.43	85.31-85.46	5.23	98.37-98.53	6.03
59.35-59.51	3.64	72.41-72.57	4.44	85.47-85.63	5.24	98.54-98.69	6.04
59.52-59.67	3.65	72.58-72.73	4.45	85.64-85.79	5.25	98.70-98.85	6.05
59.68-59.83	3.66	72.74-72.89	4.46	85.80-85.95	5.26	98.86-99.02	6.06
59.84-59.99	3.67	72.90-73.06	4.47	85.96-86.12	5.27	99.03-99.18	6.07
60.00-60.16	3.68	73.07-73.22	4.48	86.13-86.28	5.28	99.19-99.34	6.08
60.17-60.32	3.69	73.23-73.38	4.49	86.29-86.44	5.29	99.35-99.51	6.09
60.33-60.48	3.70	73.39-73.55	4.50	86.45-86.61	5.30	99.52-99.67	6.10
60.49-60.65	3.71	73.56-73.71	4.51	86.62-86.77	5.31	99.68-99.83	6.11
60.66-60.81	3.72	73.72-73.87	4.52	86.78-86.93	5.32	99.84-99.99	6.12
60.82-60.97	3.73	73.88-74.04	4.53	86.94-87.10	5.33	100.00-100.16	6.13
60.98-61.14	3.74	74.05-74.20	4.54	87.11-87.26	5.34		
61.15-61.30	3.75	74.21-74.36	4.55	87.27-87.42	5.35		

TEACHER WORK ORDER # 1 -- ANSWER SHEET

AUTO MECHANICS
COLUMBIA, MO. 65201

NAME James Rogers
ADDRESS 3874 Loggin St.
№ 002871
CITY Columbia MO

DATE	CUST. ORDER NO.	WHEN PROMISED	PHONE
Today's			445-1234

YEAR AND MAKE OF CAR - TYPE OR MODEL	SERIAL NO.
1979 Chevy Malibu - V-6	
	MOTOR NO.

LICENSE NO.	MILEAGE	WRITTEN BY
KCR-849	65,392	

AMT.	PART No.	NAME OF PART	SALE AMT.	
		Oil filter	8	00
		TOTAL PARTS ►	8.00	

ACCESSORIES – TIRES AND TUBES

TOTAL ACCESSORIES ►

DESCRIPTION OF WORK	AMOUNT	
Oil Change and Filter		
Lubricate chasis		

GAS, OIL & GREASE		
GALS. GAS		
QTS. OIL	7	45
LBS. GREASE	3	20
TOTAL GAS, OIL AND GREASE ►		

CHECK BELOW		
LUBRICATE		
CHANGE ENGINE OIL		
TRANSMISSION		
DIFFERENTIAL		
WASH		
POLISH		
TOTAL SERVICE ►		

LABOR ONLY	90	00
PARTS	8	00
ACCESSORIES		
GAS, OIL AND GREASE	10	65
MISC. MERCHANDISE		
SUBLET REPAIRS	108	65
TAX	6	66
TOTAL ►	115	31

AUTHORIZED BY

ESTIMATES ARE FOR LABOR ONLY, MATERIAL ADDITIONAL

I hereby authorize the above repair work to be done along with necessary materials. You and your employees may operate above vehicle for purposes of testing, inspection or delivery at my risk. An express mechanic's lien is acknowledged on above vehicle to secure the amount of repairs thereto. It is understood that the company assumes no responsibility for loss or damage by theft or fire to vehicles placed with them for storage, sale, repair or while road testing.

PAY THIS AMOUNT ↑

TEACHER WORK ORDER #2 - ANSWER SHEET

AUTO MECHANICS
COLUMBIA, MO. 65201

NAME Robert Johnson
ADDRESS 1814 Rosecliff Dr.
№ 002871
CITY Columbia, MO

DATE	CUST. ORDER NO.	WHEN PROMISED	PHONE
Today's			874-3209

YEAR AND MAKE OF CAR - TYPE OR MODEL	SERIAL NO.
1981 Camero	
	MOTOR NO.

LICENSE NO.	MILEAGE	WRITTEN BY
MKL-608	32,140	

AMT.	PART No.	NAME OF PART	SALE AMT.	
		Wheel cylinder	40	00
		Brake hose	13	50
		Master cylinder	16	00

TOTAL PARTS ► 69.50

ACCESSORIES – TIRES AND TUBES

TOTAL ACCESSORIES ►

DESCRIPTION OF WORK	AMOUNT	
Rebuild both wheel cylinders		
Replace brake hose		
Rebuild master cylinder		

GAS, OIL & GREASE			CHECK BELOW					
GALS. GAS			LUBRICATE			LABOR ONLY	190	00
QTS. OIL			CHANGE ENGINE OIL			PARTS	69	50
LBS. GREASE			TRANSMISSION			ACCESSORIES		
			DIFFERENTIAL			GAS, OIL AND GREASE		
			WASH			MISC. MERCHANDISE		
			POLISH			SUBLET REPAIRS	259	50
TOTAL GAS, OIL AND GREASE ►			TOTAL SERVICE ►			TAX	15	90
AUTHORIZED BY						TOTAL ►	275	40

ESTIMATES ARE FOR LABOR ONLY, MATERIAL ADDITIONAL

I hereby authorize the above repair work to be done along with necessary materials. You and your employees may operate above vehicle for purposes of testing, inspection or delivery at my risk. An express mechanic's lien is acknowledged on above vehicle to secure the amount of repairs thereto. It is understood that the company assumes no responsibility for loss or damage by theft or fire to vehicles placed with them for storage, sale, repair or while road testing.

PAY THIS AMOUNT ↑

AM #5

WORKSHEET

MEASUREMENT UNITS

As an auto mechanic, you will be using different measurement units. Below is a chart to help you solve the problems.

English	Metric
16 ounces (oz.) = 1 pound (lb.)	1000 milligrams (mg) = 1 gram (g)
2000 lb. = 1 ton	1000 g = 1 kilogram (kg) = 2.21 lb.
4 quarts = 1 gallon	1000 kg = 1 tonne = 2200 lb.
2 pints = 1 quart	28 g = 1 oz.
	454 g = 1 lb.

1. A medium-sized American car weighs 4000 pounds. What would it weigh in tons?

_______________tons

2. The lift in your shop can safely lift 11,000 pounds. How much is this in tonnes?

_____________tonnes

3. How many gallons of oil are there in 24 quarts?

_____________gallons

4. A tire jack will safely lift 650 kg. How many pounds is this?

_______________lbs.

5. A case of washers weighs 64 ounces. How many pounds is this?

_______________lbs.

6. A small foreign car weighs 1000 kg. what does it weigh in lbs.?

_______________lbs.

7. A can of grease weighs 2.2 lbs. How much does it weigh in kilograms?

________________kg.

8. A mechanic used 4 pints of windshield wiper fluid in one day. How many quarts were used?

________________qt.

9. If 1 pint of brake fluid was used in a car, how many quarts were used?

________________qt.

10. A mechanic used 56 grams of lubrication oil. How many ounces were used?

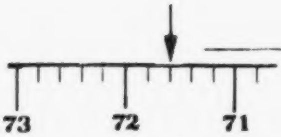
________________oz.

AM #6

WORKSHEET

MEASUREMENT INSTRUMENTS

Auto mechanics use a variety of measurement tools. Many are scales and gauges. See if you can read the scales below:

1.


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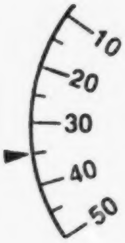
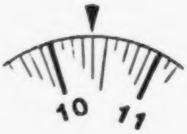
2.

10
20
30
40
50
______

3.


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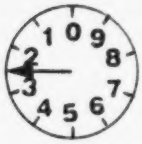
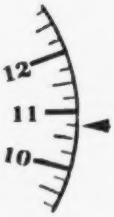
4.

0
9
8
7
6
5
4
3
2
1
______

5.


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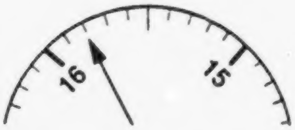
6.


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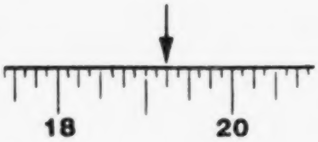
7.


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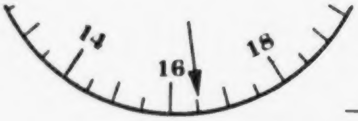
8.


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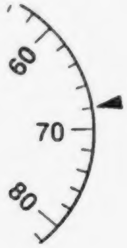
9.


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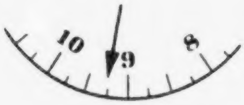
10.


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AUTO MECHANICS

Physical Demands/Working Environment

Lift 50 lbs. maximum with frequent lifting and/or carrying of objects weighing up to 25 lbs. (Medium work)
Bend body downward and forward by bending the spine at the waist (stooping)
Bend legs at the knees to come to rest on the knee or knees (kneeling)
Bend body downward and forward by bending the legs and spine (crouching)
Move about on the hands and knees or hands and feet (crawling)
Extend the hands and arms in any direction (reaching)
Seize, hold, grasp, turn or otherwise work with the hand or hands (handling)
Pick, pinch, or otherwise work with the fingers (fingering)
Perceive size, shape, temperature or texture of objects and materials by using fingertips (feeling)
Ability to work inside
Ability to work in extreme noise, constant or intermittent, causing marked distraction or possibly injury to hearing
Ability to work in extreme vibration, i.e., strain on body or extremities from repeated motion or shock
Ability to work in hazardous conditions, i.e., fumes, odors, toxic conditions, dust and poor ventilation

In most cases, the assessment of these skills will indicate that the student has the gross and fine motor skills which are prerequisites to learning the vocational skills in an Auto Mechanics program. Prior to instruction in any physical demands activities, the student should have been evaluated and parents contacted to make sure that the student has no hidden physical problems that could be aggravated by lifting objects or by other physical activities done in this area. However, if the student has a physical disability or other limitation(s) preventing him/her from demonstrating fine and gross motor skills, then other techniques may be taught so he/she can perform in the vocational program. Other persons to use as resources in this area include: physical education teacher, industrial arts teacher, special education teacher, and parents.

1. Given an object weighing between 25 lbs. and 50 lbs., student will pick up the item (using appropriate lifting techniques) and carry it at least 10 feet. (A chair, desk, box of books or other classroom items can be used for this activity.)

2. Given a variety of different sized nut and bolts, student will match correct sizes and assemble 10 to 20 pairs. This activity can be set up in a contest for speed and accuracy either between two students or an individual student against himself/herself.

3. Call a used auto parts yard and request any unsaleable parts. This can lead to a collection of screws, nuts, bolts, fan belts, gaskets, etc., which students can then use to practice identification based on size, shape, texture etc. Some of these items will probably be dirty, so student reaction to dirt can also be observed in a more realistic setting.

4. Visit an auto repair shop and have students notice the noise, vibration, dirt, grease, clothing of workers, fumes, odors, etc. Hold a discussion or ask students to write about their impressions of the above conditions.

SUGGESTIONS FOR PARENTS:

1. Have a friend, relative or parent work with the student in changing a tire, changing the oil in a car or cleaning the battery terminals.

2. Report on students physical abilities and how he or she reacts to working conditions which are noisy, and perhaps hazardous.

AUTO MECHANICS

Aptitudes - indicates an ability to:

think visually of geometric forms (S-spatial)
comprehend the two dimensional representation of three-dimensional objects (S-spatial)
recognize the relationship resulting from the movements of objects in space (S-spatial)
perceive pertinent detail in objects in pictorial or graphic material (P-form perception)
make visual comparisons and discriminations and see slight differences (P-form perception)
move the hands easily and skillfully (M-manual dexterity)
work with the hands in placing and turning motions (M-manual dexterity)

1. Given an object, diagram and necessary tools, student will assemble the object. (The teacher may want to purchase a small barbecue grill or some other object at minimal cost. Usually pictorial diagrams are part of the instructions and can be put in sequential order, copied and given to student.)

2. If student is enrolled in any industrial arts class, ask this teacher to assign a task requiring spatial ability and judge the quality of the work.

3. Given Worksheet AM #7, describe the tire markings. Have student find the markings on his/her car, the family car and/or a friend's car or teacher's car. (Answers will vary.)

4. Given Worksheet AM #8, student will match tire belt construction with 100% accuracy.

5. Given Worksheet AM #9, student will be able to identify the missing parts of the fuel system when comparing pictures to the complete schematic view with 100% accuracy.

SUGGESTIONS FOR PARENTS:

1. Allow student to assemble, or help assemble some object in the home, or help when disassembling/repairing/reassembling some appliance or object.

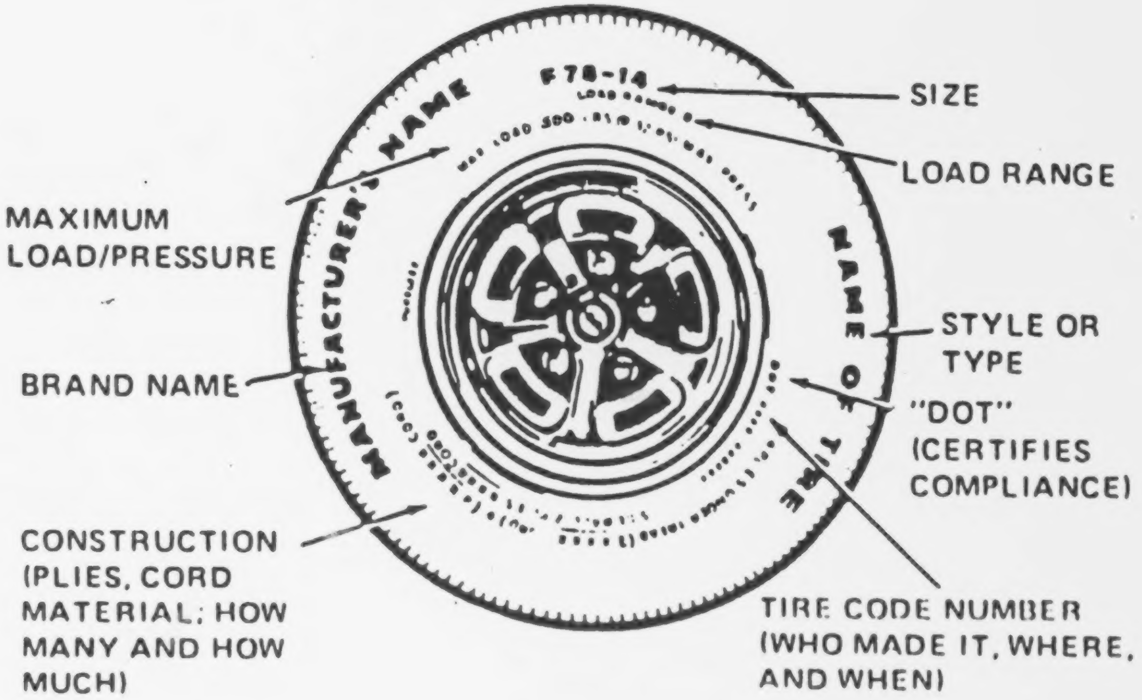
2. Allow student to fill the car with gas, take tire pressure, fill tires with air (and recheck pressure), and check the oil.

AM #7

WORKSHEET

TIRE MARKINGS

Below is a picture of a tire with descriptions of all the markings. Locate all of this information on at least two car tires. On a piece of paper list all the markings you found and turn your list into your teacher.

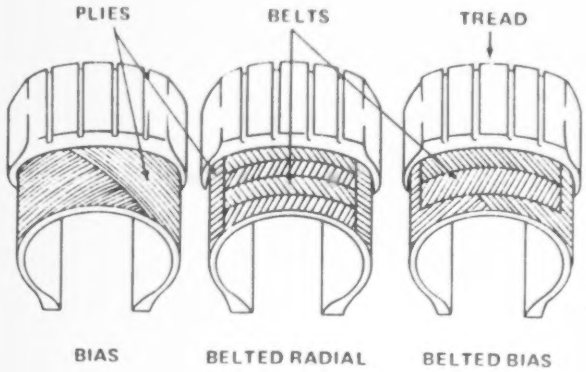

F78-14
MANUFACTURER'S NAME
NAME OF TIRE
SIZE
LOAD RANGE
MAXIMUM LOAD/PRESSURE
STYLE OR TYPE
BRAND NAME
"DOT" (CERTIFIES COMPLIANCE)
CONSTRUCTION (PLIES, CORD MATERIAL; HOW MANY AND HOW MUCH)
TIRE CODE NUMBER (WHO MADE IT, WHERE, AND WHEN)

AM #8

WORKSHEET

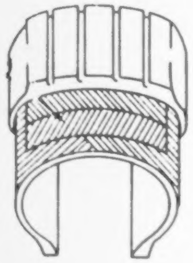
TIRE BELT CONSTRUCTION

There are 3 types of tire construction.


PLIES
BELTS
TREAD
BIAS
BELTED RADIAL
BELTED BIAS

#1 #2 #3

Match each tire construction below with one of the tires above.



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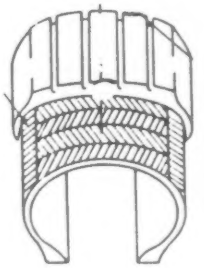

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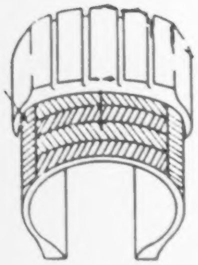

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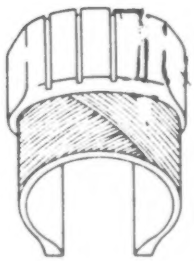

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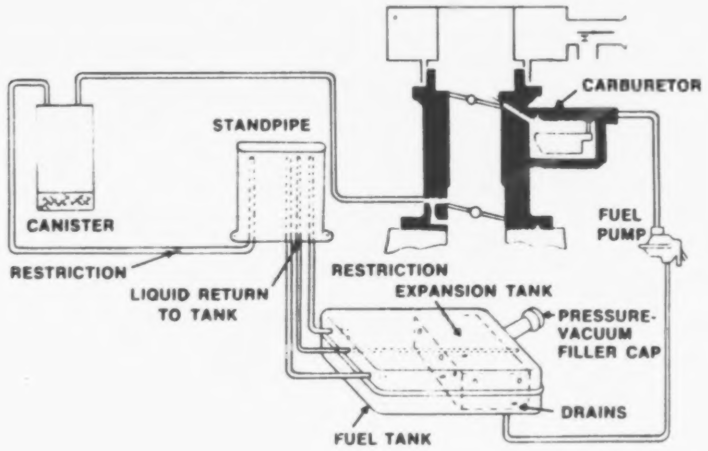
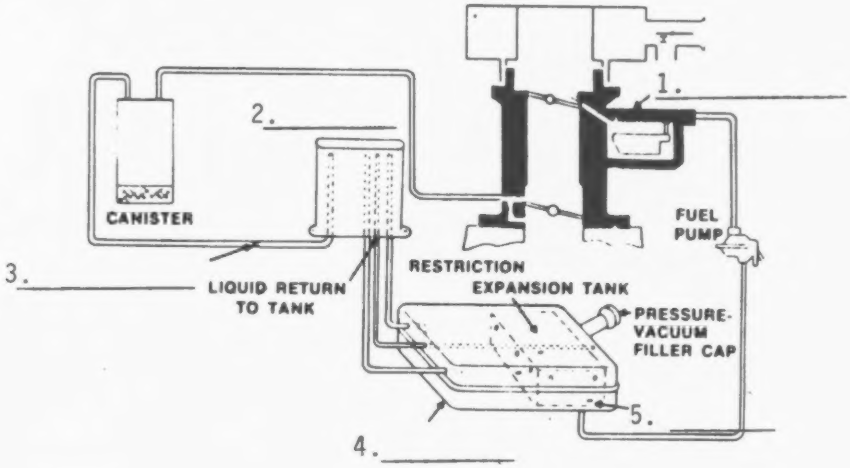
WORKSHEET

MISSING PARTS IDENTIFICATION

Below is a complete schematic view of a fuel evaporation system. Study it, then look at the picture below and identify the missing parts.


CARBURETOR
STANDPIPE
CANISTER
FUEL PUMP
RESTRICTION
RESTRICTION
LIQUID RETURN TO TANK
EXPANSION TANK
PRESSURE-VACUUM FILLER CAP
DRAINS
FUEL TANK


1. ____________
2. ____________
CANISTER
FUEL PUMP
3. ____________
RESTRICTION
LIQUID RETURN TO TANK
EXPANSION TANK
PRESSURE-VACUUM FILLER CAP
5. ____________
4. ____________

AUTO MECHANICS

Temperament - indicates an ability to adapt to:

making generalizations, evaluations, or decisions based on measurable or verifiable criteria
situations requiring the precise attainment of set limits, tolerances, or standards
performing a variety of duties, often changing from one task to another of a different nature without loss of efficiency or composure

1. Using an auto parts catalog, design a worksheet whereby student must find an auto part in the catalog, and record specified information about the part (cost, part number, weight, etc.).

2. Discuss how to check the oil in a car. If possible, bring an oil dipstick to class and have student identify the markings and state which mark indicates that oil is needed.

3. If student has difficulty with task changes, discuss with student how you can help him/her by interrupting an assigned task every so often and requesting him/her to do something different.

SUGGESTIONS FOR PARENTS:

1. Discuss with student the importance of high quality workmanship in every task performed.

2. Require that student be able to explain the reasons behind decisions he/she makes. Even simple decisions such as choosing which movie to go to, what is eaten for lunch, etc. This process will help build decision making skills.

AUTO MECHANICS

Vocational

Identify basic hand tools and equipment
Use basic hand tools and equipment
Demonstrate knowledge of basic safety concepts

1. Visit the industrial arts class and have student find as many tools as possible on the tool list.
2. Using a catalog (from Sears, an auto parts catalog, etc.) have student find pictures of as many tools on the tool list as possible. Have him/her identify other tools also that might be used by an auto mechanic and state how the tool is used.
3. Have student list as many safety rules, dangers, and hazards as possible related to engine repair, shop safety and tool safety. A partial listing is provided in Worksheet AM #10.

SUGGESTIONS FOR PARENTS:

1. Have student inventory tools around the house.
2. Allow student to practice using basic hand tools, such as hammers, screwdrivers, files, etc.
3. Have student perform a safety evaluation of the home.

WORKSHEET

SAFETY RULES/HAZARDS

1. Work quietly and give the job your undivided attention.

2. Keep your tools and equipment under control.

3. Keep jack handles out of the way. After using a creeper, prop it against the wall with the wheels out (so that the wheels will not mark the wall).

4. Never indulge in horseplay or other foolish activities. You could cause someone to get seriously hurt.

5. Don't put sharp objects, such as screwdrivers, in your pocket. You could cut yourself or get stabbed. Or you could ruin the upholstery in a car.

6. Make sure your clothes are suitable for the job. Dangling sleeves or ties can get caught in machinery and cause serious injuries. Do not wear sandals or open-toe shoes. Wear full leather shoes with nonskid rubber heels and soles. Steel-toe safety shoes are best for shopwork.

7. Wipe excess oil and grease off your hands and tools so that you can get a good grip on tools or parts.

8. If you spill oil or grease, or any liquid, on the floor, clean it up so that no one will slip and fall.

9. Never use compressed air to blow dirt from your clothes. Never point a compressed-air hose at another person. Flying particles could injure an eye.

10. Always wear goggles or a face shield on any job where there is danger from flying particles.

11. Watch out for flying sparks from the grinding wheel or when you are welding. The sparks can set your clothes on fire.

12. To protect your eyes, wear goggles when using chemicals, such as solvents. If you get a chemical in your eyes, wash it out with water at once. See the school nurse as soon as possible.

13. When using a shop jack, make sure it is centered so that it won't slip. And never, never jack up a car while someone is working under it!

14. Always use the right tool for the job. The wrong tool could damage the part being worked on and could also cause you to get hurt.

AUTO MECHANICS RESOURCES

Barron's Educational Series, Inc.
113 Crossways Park Dr.
Woodbury, NY 11797

Survival Mathematics. (1983). Williams, E.

Delmar Publishers, Inc.
2 Computer Drive West
Box 15-015
Albany, NY 12212

Practical Problems in Mathematics for Automotive Technicians. (1985). Moore, G.

Educational Design, Inc.
47 West 13 Street
New York, NY 10011

Math: For the World of Work. (1982). Crowell, C. E.

Instructional Materials Lab
908 Woodson Way
University of Missouri - Columbia
Columbia, MO 65211

- Vocational Related Math
- Auto Service
- Torque and Torque Wrenches
- Micrometer, Calipers and Gauges
- Auto Mechanics Series
  - Intro to Auto Mechanics
  - Engine Rebuilding and Exhaust Systems
  - Fuel System/Service
  - Cooling and Lubrication Systems/Service
  - Electrical Systems and Tune-up
  - Power Trains/Service
  - Suspension and Steering Systems/Service
  - Brake Systems/Service
  - Accessories: AC, Speed Control/Service
  - Understanding and Measuring Power
  - Parts Specialist

Occupational Curriculum Laboratory
East Texas State University
Commerce, Texas 75428

General Mechanical Repair

Southwestern Publishing Co.
355 Conde Street
W. Chicago, IL 60185

Math for the Automotive Trade. (1983). Peterson, J. C., & deKrugger, W.

78

BUILDING MAINTENANCE/CUSTODIAL

Sample Occupational Areas

Janitor
Housekeeping
Maintenance Mechanic Helper

Introduction

Not all area vocational schools have a training program in building maintenance/custodial. The Vocational Instructional Management System (VIMS) has not yet been developed for this training area. However, instructors in this area usually have their own competencies for the course. If a student is interested in this field, contact the area vocational school and request a copy of the competencies for this class.

Students interested in this occupational area should possess good dexterity skills and safety habits. They may work with hazardous cleaning fluid and run machinery. Some jobs in this area require workers to handle repetitive activities, while other jobs require the flexibility to perform a variety of tasks. Students should be made aware of the career ladders (promotions) available to them in different industry settings in the local community.

BUILDING MAINTENANCE/CUSTODIAL
ACCESS SKILLS CHECKLIST

Student Name/ID ______________________ Sending School ______________________

Instructor ______________________ Date(s) Evaluated ______________________

Circle proper mastery code: 3 = MASTERY 2 = REQUIRES SUPERVISION
1 = NOT MASTERED N or blank = NO EXPOSURE

TASK DESCRIPTION	TASK ID #	MASTERY CODE	MASTERY DATE	RETRY CODE/DATE
1. Count two-place numbers	460400A001	3 2 1 N	________	________
2. Add two-place numbers	460400A002	3 2 1 N	________	________
3. Subtract two-place numbers	460400A003	3 2 1 N	________	________
4. Perform standard units of measurement, i.e., cup, pint, quart, inch, foot, yard, ounce, pound	460400A004	3 2 1 N	________	________
5. Use basic measuring instruments, i.e., rulers, scales	460400A005	3 2 1 N	________	________
6. Lift 50 lbs. maximum with frequent lifting and/or carrying of objects weighing up to 25 lbs. (Medium work)	460400B001	3 2 1 N	________	________
7. Ascend or descend, i.e., ladders, stairs, scaffolding, using the feet and legs and/or hands and arms (climbing)	460400B002	3 2 1 N	________	________
8. Maintain body equilibrium to prevent falling when walking, standing, crouching or running (balancing)	460400B003	3 2 1 N	________	________
9. Bend body downward and forward by bending the spine at the waist (stooping)	460400B004	3 2 1 N	________	________
10. Bend legs at the knees to come to rest on the knee or knees (kneeling)	460400B005	3 2 1 N	________	________
11. Bend body downward and forward by bending the legs and spine (crouching)	460400B006	3 2 1 N	________	________
12. Move about on the hands and knees or hands and feet (crawling)	460400B007	3 2 1 N	________	________
13. Extend the hands and arms in any direction (reaching)	460400B008	3 2 1 N	________	________
14. Seize, hold, grasp, turn or otherwise work with the hand or hands (handling)	460400B009	3 2 1 N	________	________
15. Pick, pinch, or otherwise work with the fingers (fingering)	460400B010	3 2 1 N	________	________
16. Perceive size, shape, temperature or texture of objects and materials by using fingertips (feeling)	460400B011	3 2 1 N	________	________
17. Ability to work inside	460400B012	3 2 1 N	________	________
18. Move the hands easily and skillfully (M-manual dexterity)	460400C001	3 2 1 N	________	________
19. Work with the hands in placing and turning motions (M-manual dexterity)	460400C002	3 2 1 N	________	________

BUILDING MAINTENANCE/CUSTODIAL
ACCESS SKILLS CHECKLIST

Student Name/ID ______________________ Sending School ______________________

Instructor ______________________ Date(s) Evaluated ______________________

Circle proper mastery code: 3 = MASTERY 2 = REQUIRES SUPERVISION
1 = NOT MASTERED N or blank = NO EXPOSURE

TASK DESCRIPTION	TASK ID #	MASTERY CODE	MASTERY DATE	RETRY CODE/DATE
20. Performing repetitive work, or performing continuously the same work, according to set procedures, sequences, or pace	460400D001	3 2 1 N		
21. Performing a variety of duties, often changing from one task to another of a different nature without loss of efficiency or composure	460400D002	3 2 1 N		
22. Identify basic hand tools and equipment	460400E001	3 2 1 N		
23. Use basic hand tools and equipment	460400E002	3 2 1 N		
24. Demonstrate knowledge of basic safety concepts	460400E003	3 2 1 N		

BUILDING MAINTENANCE/CUSTODIAL VOCABULARY LIST

BASIN	a type of sink
DROP CLOTH	large canvas, plastic or heavy paper sheet used to protect an area from drips and spills
LATEX PRIMER	type of paint needed as a first coat on bare areas
LAVATORY	another name for a bathroom
SOAK	to get something very, very wet
SOLVENT	a liquid used to "thin" paint and clean brushes
SPACKLING COMPOUND	white, putty like material used to fill holes and cracks in plaster or drywall walls
SPONGE	a light weight material which soaks up liquids
STAIN REMOVER	liquid which takes out smudges in objects
WHISK BROOM	small broom used to dust furniture or get into small corners

BUILDING MAINTENANCE/CUSTODIAL

TOOL LIST

- Broom
- Buffer
- Dry mop
- Hammer
- Pliers
- Plumber's snake
- Plunger
- Screwdriver
- Shampooer
- Stepladder
- Trash cart
- Utility cart
- Vacuum cleaner
- Wet/dry vacuum
- Wet mop

BUILDING MAINTENANCE/CUSTODIAL

Math Skills

Count two-place numbers
Add two-place numbers
Subtract two-place numbers
Perform standard units of measurement, i.e., cup, pint, quart, inch, foot, yard, ounce, pound
Use basic measuring instruments, i.e., rulers, scales

NOTE: Many math books and workbooks provide needed direction in learning basic operations in math. This section assumes that students have basic skills and is designed to be used in conjunction with any of the math books you might be using, or to establish your own supplemental units. Any math practice activities should be developed within the context of the vocational program. Other persons to use as resources in this area include: parents, math teacher, and industrial arts teacher.

1. After being given directions on how to complete an inventory, student will develop an inventory list and complete an inventory in the classroom.

2. If possible, arrange a time with the building custodian when the student can complete an inventory on the school's building maintenance supplies/equipment. Have student return in 2-4 weeks and update inventory by subtracting what has been used.

3. Student will compute each gross weekly and monthly wage given an hourly salary of $3.35, $4.50, $5.00, and $6.50.

4. Student will identify everyday objects that use standard units of measurement, such as pints, quarts, gallons of milk, paint, etc. Several students could brainstorm items and develop a list for each of the following units: CUP, QUART, GALLON; INCH, FEET, YARD; OUNCE, POUND.

5. Given worksheet BM/C #1, student will complete the math problems with 80% accuracy.

   Answers to Worksheet BM/C #1:

   1. 32
   2. $51.00
   3. $44.06
   4. 10 cups
   5. Depends upon window size

6. Student will demonstrate accuracy in measurement by:

   (a) measuring room dimensions
   (b) drawing a box 3" square
   (c) drawing a rectangle 2 1/4" by 10 5/16".

SUGGESTIONS FOR PARENTS:

1. Encourage student to complete an inventory of all cleaning solutions in the home.

2. Have student price each of the solutions and determine the total cost.

3. Have student measure rooms in the home and draw the first floor of the house to scale.

4. Have student mix cleaning solutions with water. Note whether the measurements (i.e., 1 part to 3 parts) are correct.

WORKSHEET

SOLVING PROBLEMS

1. A maintenance worker replaced ceiling tile in a bathroom. 95 pieces of tile were ordered. The worker used 63 tiles for the job. How many tiles were left? ________________

2. The maintenance worker spent 6 hours at the job. The hourly wage was $8.50. How much did the worker earn in 6 hours? ____________________

3. On a small remodeling job, a maintenance worker installed 4 fluorescent lights at $1.89 each, 10 electrical plates at $ .50 each, and 2 panes of glass at $15.75 each. How much did the materials cost all together? $______________

4. A custodian needs to wax a floor that measures 20 x 20. Five (5) cups of the wax mixture will cover 200 square feet of a floor. How many cups need to be used to finish the floor? ______________cups

5. Find the dimensions on one window in your classroom (HINT: Measure the window's length and height).

BUILDING MAINTENANCE/CUSTODIAL

Physical Demands/Working Environment

Lift 50 lbs. maximum with frequent lifting and/or carrying of objects weighing up to 25 lbs. (medium work)
Ascend or descend, i.e., ladders, stairs, scaffolding, using the feet and legs and/or hands and arms (climbing)
Maintain body equilibrium to prevent falling when walking, standing, crouching or running (balancing)
Bend body downward and forward by bending the spine at the waist (stooping)
Bend legs at the knees to come to rest on the knee or knees (kneeling)
Bend body downward and forward by bending the legs and spine (crouching)
Move about on the hands and knees or hands and feet (crawling)
Extend the hands and arms in any direction (reaching)
Seize, hold, grasp, turn or otherwise work with the hand or hands (handling)
Pick, pinch, or otherwise work with the fingers (fingering)
Perceive size, shape, temperature or texture of objects and materials by using fingertips (feeling)
Ability to work inside

In most cases, the assessment of these skills will indicate that the student has the gross and fine motor skills which are prerequisites to learning the vocational skills in a Building Maintenance/Custodial program. Prior to instruction in any physical demands activities, the student should have been evaluated and parents contacted to make sure that the student has no hidden physical problems that could be aggravated by lifting objects or by other physical activities done in this area. However, if the student has a physical disability or other limitation(s) preventing him/her from demonstrating fine and gross motor skills, then other techniques may be taught so he/she can perform in the vocational program. Other persons to use as resources in this area include: physical education teacher, industrial arts teacher, special education teacher, and parents.

1. Student will identify objects weighing approximately 25 lbs. and 50 lbs.

2. After reviewing the instructional modules entitled "Physical Demand Movements," student will demonstrate proper lifting techniques on a 25 lb. item and carry it 10 feet. If completed easily, student will lift the 50 lb. item.

3. Check with the physical education teacher concerning the student's dexterity skills and balancing ability.

4. Ask the custodian (or a representative from a cleaning business) to demonstrate the use of a buffing machine or carpet shampooer. Student will act as the "helper" and demonstrate ability to kneel, stoop, crouch, reach, etc.

5. Student will identify, by feel, different temperatures of water (cold, cool, luke warm, hot).

6. Given different samples of sandpaper, student will sort them, by feeling, into groups according to their roughness.

SUGGESTIONS FOR PARENTS:

1. Report student's ability to maintain balance when climbing up and down a ladder.

2. Report on student's ability to do quality work on household cleaning chores.

3. Allow student to do minor maintenance chores in the home, such as changing lightbulbs, painting, etc.

BUILDING MAINTENANCE/CUSTODIAL

Aptitudes - indicates an ability to:

move the hands easily and skillfully (M-manual dexterity)
work with the hands in placing and turning motions (M-manual dexterity)

1. Have student clean the blackboard in the classroom. Prior to doing this, have student list the steps in cleaning. He/she might ask the custodian if there are special cleaning fluids to use.
2. If your classroom has a window, borrow a squeegee from home or the custodian, and have student clean the window, using the squeegee. (When completed there should be no smears or streaks).
3. Hold a "cleaning day" where all students develop a list of what needs to be done, bring in cleaning supplies, and clean the room.
4. Student will find and cut out ads from a magazine or newspaper which show cleaning products or equipment. A collage can be made, or an oral report to the class on the "claims" the ads make.

SUGGESTIONS FOR PARENTS:

1. Encourage student to sweep and wet-mop the kitchen or bathroom floor. Inspect the job when completed.
2. Ensure that student can carry a ladder, set it up and collapse it safely.

BUILDING MAINTENANCE/CUSTODIAL

Temperament - indicates an ability to adapt to:

performing repetitive work, or performing continuously the same work, according to set procedures, sequences, or pace
performing a variety of duties, often changing from one task to another of a different nature without loss of efficiency or composure

1. Student will interview the custodian of the building about his/her daily routine. Then have student report (written or oral) on the tasks.

2. Student will develop a list of jobs which require repetitive types of activities, using the Occupational Outlook Handbook (available in most counseling offices). The jobs do not necessarily have to be related to building maintenance/custodial work, but student should be able to identify which of the jobs might be related to this occupational area.

3. Using the yellow pages (or visiting businesses) student will identify 1) potential employers 2) businesses which sell supplies for this occupational area and 3) list 25 businesses which might use a cleaning/custodial service (versus those who would probably do their own cleaning; i.e. small businesses).

SUGGESTIONS FOR PARENTS:

1. Have student make a list of "spring cleaning" or "heavy cleaning" chores which need to be done: Let student pick 2 of the jobs to complete. Note whether these jobs are repetitive or have variety.

BUILDING MAINTENANCE/CUSTODIAL

Vocational

identify basic hand tools and equipment
use basic hand tools and equipment
demonstrate knowledge of basic safety concepts

1. Gain permission from the custodian for student to tour the supply and equipment room. Student will identify the tools and equipment on the tools list, and add to the list, if necessary.
2. Student will interview the school custodian and develop a list of safety factors to be observed in this occupation.
3. Student will locate safety warnings on at least 3 different cleaning products and be able to state the dangers of each of the products.

SUGGESTIONS FOR PARENTS:

1. Report on student's ability to use basic hand tools, vacuum cleaners, mops, and other equipment used in this occupational area.
2. Have student choose one room in the house for a thorough cleaning. Have him/her develop a list of all the tasks. Check for accuracy and completeness.

BUILDING MAINTENANCE RESOURCES

Educational Design, Inc.
47 West 13th Street
New York, NY 10011

Math for the World of Work

Instructional Materials Laboratory
908 Woodson Way
University of Missouri-Columbia
Columbia, MO 65211

Building Maintenance - Special Needs Curriculum
Building and Grounds Maintenance - Vocabulary Module
Developing Shop Safety Skills

Maryland Vocational Curriculum
Research and Development Center
Department of Industrial, Technological
and Occupational Education
University of Maryland
J.M. Patterson Building
College Park, Maryland 20742

Custodial Learning Activity Packets

Occupational Curriculum Laboratory
East Texas State University
Commerce, Texas 75428

Building Maintenance: Introduction
Building Maintenance: Electrical
Building Maintenance: Masonry
Building Maintenance: Carpentry

DIESEL MECHANICS

Sample Occupational Areas
Diesel Mechanic Apprentice
Diesel Mechanic Helper
Engine Repairer
Maintenance Mechanic Helper
Tractor Mechanic Helper

Introduction

For many area vocational schools, a student interested in diesel mechanics will have taken a course in small engine repair and/or welding. Some students will also have had auto mechanics. Diesel mechanics is closely related to the Agricultural Power II class. This class works on large farm equipment which often has similar components to heavy equipment and diesel trucks.

As in any mechanical trade area, students should have good dexterity and coordination skills. In a diesel mechanics shop, conditions with fumes, dust and noise exist. Students interested in this area should also be able to work independently and safely.

VIMS COMPETENCIES FOR DIESEL MECHANICS

A. Basic Skills

1. Operate safely in the workshop
2. List shop safety rules and regulations
3. Inspect work areas for safe work environment
4. Identify and use hand and power tools
5. Use reference books, parts books and charts
6. Perform basic mathematical calculations
7. Operate heavy duty diesel vehicle
8. Identify and select common fasteners
9. Identify and select common seals and gaskets
10. Use precision measurement tools

Other (specify): ____________________

____

____

B. Perform Preventive Maintenance Tests

1. Demonstrate safety procedures and precautions
2. Test cooling system
3. Test engine lubrication system
4. Check air intake and/or exhaust system
5. Draw lubrication and/or oil sample
6. Check linkage adjustments
7. Perform visual inspection
8. Replace fuel filters
9. Inspect, adjust and maintain fifth wheel
10. Inspect steering linkage for wear
11. Inspect and adjust brakes
12. Test air brake system

Other (specify): ____________________

____

____

C. Perform Engine Tune-Up

1. Demonstrate safety procedures and precautions
2. Adjust supplementary governing and/or control devices
3. Adjust intake and exhaust valves according to specifications
4. Adjust injectors according to specifications
5. Adjust governor (as applicable)

Other (specify): ____________________

____

____

D. Maintain and Service Cooling System

1. Demonstrate safety procedures and precautions
2. Replace and adjust fan and auxiliary belts
3. Replace water filter
4. Replace and/or test radiators
5. Flush cooling system
6. Replace and test thermostat and seals
7. Replace hoses and clamps
8. Inspect fan drive assembly and related hardware
9. Replace water pump
10. Test and replace oil cooler
11. Test radiator coolant
12. Recognize proper routing and sizing of cooling lines
13. Pressure test cooling system

Other (specify): ____________________

____

____

E. Service Diesel Fuel System

1. Demonstrate safety procedures and precautions
2. Test injection nozzles and injectors
3. Time fuel injection pump
4. Bleed fuel system
5. Replace injection nozzles and injectors
6. Test fuel system
7. Identify and install fuel line hoses and connections
8. Inspect turbo charger condition

Other (specify): ____________________

____

____

F. Diagnosis/Trouble-shooting

1. Demonstrate safety procedures and precautions
2. Evaluate problem
3. Trouble-shoot overheating and overcooling
4. Trouble-shoot engine vibration
5. Trouble-shoot electrical system
6. Trouble-shoot low and/or high oil pressure
7. Trouble-shoot smoke
8. Trouble-shoot leaks and/or contamination
9. Trouble-shoot hard starting
10. Trouble-shoot high oil consumption
11. Trouble-shoot fuel system
12. Trouble-shoot internal noises
13. Trouble-shoot low power and/or performance
14. Trouble-shoot air system
15. Trouble-shoot low fuel mileage

Other (specify): ____________________

____

____

G. Maintain and Service Lubrication System

1. Demonstrate safety procedures and precautions
2. Evaluate oil conditions
3. Replace and inspect oil filter
4. Change engine oil
5. Change transmission and/or differential oils
6. Change power steering fluid
7. Lubricate chassis components

8. Replace transmission and/or differential filters
Other (specify):
____
____
____

H. Disassemble Engine

1. Demonstrate safety procedures and precautions
2. Remove engine
3. Remove injection pump
4. Remove camshaft and bushings
5. Remove cylinder ridge, pistons and liner
6. Remove crankshaft
7. Remove oil pump
8. Remove cylinder head
9. Remove exterior components
Other (specify):
____
____
____

I. Rebuild Components

1. Demonstrate safety procedures and precautions
2. Clean components
3. Inspect flywheel
4. Rebuild oil pump
5. Repair and rethread tapped holes
6. Rebuild cylinder heads
7. Rebuild or replace accessories
Other (specify):
____
____
____

J. Reassemble Engine

1. Demonstrate safety procedures and precautions
2. Install camshaft and bushings
3. Install crankshaft
4. Install cylinder liners
5. Install piston rod
6. Install piston in cylinder
7. Install oil pump
8. Install timing gears
9. Install cylinder head
10. Install injection pump
11. Install exterior components
12. Adjust valve bridge or crosshead
13. Prime and pressurize fuel, lubrication and cooling system
14. Tune engine
15. Test run engine
16. Install engine
Other (specify):
____
____
____

K. Electrical

1. Demonstrate safety procedures and precautions
2. Demonstrate knowledge of basic electricity
3. Perform common diagnostic tests
4. Evaluate test results
5. Interpret schematic
6. Repair and/or replace starter
7. Remove and replace battery
8. Remove and replace associate wiring and/or switches (solenoids/relays/contacts)
9. Remove and install generator and/or alternator
10. Use trouble-shooting charts
Other (specify):
____
____
____

L. Welding

1. Demonstrate safety procedures and precautions
2. Use cutting torch
3. Weld with arc welder in flat position
4. Braze fittings
5. Braze light gauge flat
6. Weld oxyacetylene flat
Other (specify):
____
____
____

M. Hydraulics

1. Identify basic principles of hydraulics
2. Identify basic hydraulic components
Other (specify):
____
____
____

N. Air Conditioning and Refrigeration

1. Demonstrate safety procedures and precautions
2. Demonstrate an understanding of basic AC theory and operation
3. Remove and replace major components
4. Evacuate and charge system
Other (specify):
____
____
____

O. Steering and Suspension

1. Demonstrate safety procedures and precautions
2. Adjust axle alignment
3. Remove and replace springs and pins
4. Rebuild steering sector and hydraulic pump
5. Remove and replace king pin
6. Remove and replace steering components
7. Inspect, remove and replace mounted tires
Other (specify):
____
____
____

P. Brakes

1. Demonstrate safety procedures and precautions
2. Repair cam, wedge and disc brakes
3. Service hydraulic brake system
4. Inspect brake drum and/or rotors using safety specifications
5. Replace spring brake chambers and diaphragms
6. Service air brake system
7. Diagnose, remove and replace hydrovacs

Other (specify):

____
____
____

Q. Power Train

1. Demonstrate safety procedures and precautions
2. Remove and replace clutch assembly
3. Adjust clutch free play
4. Install throw-out bearing
5. Remove, adjust and replace drive line
6. Remove and replace transmission (manual and automatic)
7. Remove and replace axle shaft
8. Replace and adjust wheel bearings
9. Service hubs
10. Check drive line alignment
11. Remove and replace differential

Other (specify):

____
____
____

Leadership Competencies **

1. Demonstrate an understanding of VICA, its structure and activities
2. Demonstrate an understanding of one's personal values
3. Perform tasks related to effective management skills
4. Demonstrate interpersonal skills
5. Demonstrate etiquette and courtesy
6. Demonstrate effectiveness in oral and written communications
7. Develop and maintain a code of professional ethics
8. Maintain a good professional appearance
9. Perform basic tasks related to securing and terminating employment
10. Perform basic parliamentary procedures in a group meeting

** (Note: These competencies are addressed in the Missouri VICA Curriculum Guide lessons.)

DIESEL MECHANICS
ACCESS SKILLS CHECKLIST

Student Name/ID ____________________ Sending School ____________________

Instructor ____________________ Date(s) Evaluated ____________________

Circle proper mastery code: 3 = MASTERY 2 = REQUIRES SUPERVISION
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TASK DESCRIPTION	TASK ID #	MASTERY CODE	MASTERY DATE	RETRY CODE/DATE
1. Count two-place numbers		3 2 1 N		
2. Add two-place numbers		3 2 1 N		
3. Subtract two-place numbers		3 2 1 N		
4. Perform standard units of measurement, i.e., cup, pint, quart, inch, foot, yard, ounce, pound		3 2 1 N		
5. Use basic measuring instruments, i.e., rulers, scales		3 2 1 N		
6. Multiply two-place numbers		3 2 1 N		
7. Divide two-place numbers		3 2 1 N		
8. Add common fractions		3 2 1 N		
9. Subtract common fractions		3 2 1 N		
10. Multiply common fractions		3 2 1 N		
11. Divide common fractions		3 2 1 N		
12. Add two-place decimals		3 2 1 N		
13. Subtract two-place decimals		3 2 1 N		
14. Multiply two-place decimals		3 2 1 N		
15. Divide two-place decimals		3 2 1 N		
16. Add surface areas, values, weights and measures		3 2 1 N		
17. Subtract surface areas, values, weights and measures		3 2 1 N		
18. Multiply surface areas, values, weights and measures		3 2 1 N		
19. Divide surface areas, values, weights and measures		3 2 1 N		
20. Lift 100 lbs. maximum with frequent lifting and/or carrying of objects weighing up to 50 lbs. (heavy work)		3 2 1 N		
21. Bend body downward and forward by bending the spine at the waist (stooping)		3 2 1 N		
22. Bend legs at the knees to come to rest on the knee or knees (kneeling)		3 2 1 N		
23. Bend body downward and forward by bending the legs and spine (crouching)		3 2 1 N		

DIESEL MECHANICS
ACCESS SKILLS CHECKLIST

Student Name/ID ______________________ Sending School ______________________

Instructor ______________________ Date(s) Evaluated ______________________

Circle proper mastery code: 3 = MASTERY 2 = REQUIRES SUPERVISION
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TASK DESCRIPTION	TASK ID #	MASTERY CODE	MASTERY DATE	RETRY CODE/DATE
24. Move about on the hands and knees or hands and feet (crawling)		3 2 1 N	________	________
25. Extend the hands and arms in any direction (reaching)		3 2 1 N	________	________
26. Seize, hold, grasp, turn or otherwise work with the hand or hands (handling)		3 2 1 N	________	________
27. Pick, pinch, or otherwise work with the fingers (fingering)		3 2 1 N	________	________
28. Perceive size, shape, temperature or texture of objects and materials by using fingertips (feeling)		3 2 1 N	________	________
29. Ability to work inside		3 2 1 N	________	________
30. Ability to work in extreme noise, constant or intermittent, causing marked distraction or possibly injury to hearing		3 2 1 N	________	________
31. Ability to work in extreme vibration, i.e., strain on body or extremities from repeated motion or shock		3 2 1 N	________	________
32. Think visually of geometric forms (S-spatial)		3 2 1 N	________	________
33. Comprehend the two dimensional representation of three-dimensional objects (S-spatial)		3 2 1 N	________	________
34. Recognize the relationship resulting from the movements of objects in space (S-spatial)		3 2 1 N	________	________
35. Perceive pertinent detail in objects in pictorial or graphic material (P-form perception)		3 2 1 N	________	________
36. Make visual comparisons and discriminations and see slight differences (P-form perception)		3 2 1 N	________	________
37. Coordinate eyes and hands or fingers rapidly and accurately (K-motor coordination)		3 2 1 N	________	________
38. Make a movement response accurately and swiftly (K-motor coordination)		3 2 1 N	________	________
39. Move the fingers and manipulate small objects with the fingers, rapidly or accurately (F-finger dexterity)		3 2 1 N	________	________

DIESEL MECHANICS
ACCESS SKILLS CHECKLIST

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Instructor ______________________ Date(s) Evaluated ______________________

Circle proper mastery code: 3 = MASTERY 2 = REQUIRES SUPERVISION
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TASK DESCRIPTION	TASK ID #	MASTERY CODE	MASTERY DATE	RETRY CODE/DATE
40. Making generalizations, evaluations, or decisions based on measurable or verifiable criteria		3 2 1 N		
41. Situations requiring the precise attainment of set limits, tolerances, or standards		3 2 1 N		
42. Performing a variety of duties, often changing from one task to another of a different nature without loss of efficiency or composure		3 2 1 N		
43. Identify basic hand tools and equipment		3 2 1 N		
44. Use basic hand tools and equipment		3 2 1 N		
45. Demonstrate knowledge of basic safety concepts		3 2 1 N		

DIESEL MECHANICS VOCABULARY

ABDC	abbreviation for "after bottom dead center"
ABRASION	a wearing away caused by rubbing
ACCUMULATOR	a device used for storing liquid under pressure
ADVANCE	to adjust the fuel injection so that fuel enters the engine at a greater number of degrees before top dead center
AIR BLEEDER	a device used to remove air from a hydraulic system
AIR/FUEL RATIO	the ratio (by weight or by volume) between air and fuel
ALIGN	to bring two or more components of a unit into the correct position with respect to one another
ALLOWANCE	the difference between the minimum and the maximum dimensions of proper functioning
ANNEAL	to toughen metals by heating and then cooling them
API	abbreviation for American Petroleum Institute
ARMATURE	the movable part of a relay, regulator, or horn or the rotating part of a generator or starter
ATDC	abbreviation for "after top dead center"
AXIS	a centerline
AXLE	a crossbar which supports a vehicle and with which, or on which, its wheels turn
BALANCED VALVE	a valve in which the fluid pressure is equal on both sides (i.e., the opening and closing directions)
BALL BEARING	a bearing using steel balls as its rolling element between the inner and outer ring
BATTERY	an electrochemical device that produces electric current
BBDC	abbreviation for "before bottom dead center"
BDC	abbreviation for "bottom dead center"
BERNOULLI'S PRINCIPLE	given a fluid flowing through a tube, any constriction or narrowing of the tube will create an increase in that fluid's velocity and a decrease in its pressure
BODY	a structure for cargo or passengers, mounted on the chassis

BORE	a cylinder or hole, or the inside diameter of the cylinder or hole
BRAKE	the mechanism used to retard or stop the movement of a vehicle
BRAKE DRUM	a steel, cast iron, or aluminum machined housing, bolted to the wheel, that rotates with the wheel around the brake shoes
BRAKE FLUID	a special fluid used in hydraulic brake system
BREAKER ARM	the movable arm to which one of the breaker points is attached
BRITISH THERMAL UNIT (BTU)	a U.S. Customary System unit of measure. Approximate definition: the amount of heat required to raise 1 lb of water 1 degree Fahrenheit
BTDC	abbreviation for "before top dead center"
BUSHING	a metallic or synthetic lining for a hole which reduces or prevents abrasion between components
CALIBRATE	to make an adjustment to a meter or other instrument so that it will indicate accurately its input
CALORIE	the amount of heat required 1 gram of water from 17 to 18 degrees Celsius
CAMBER	the amount, in millimeters or degrees, that the front wheels of a vehicle are tilted outwards at the top from a true vertical. Outward tilting of the wheels at the top produces "positive" camber and inward tilting produces "negative" camber
CHASSIS	the framework of a motor vehicle including the power plant (engine), power transmission units, axles, and wheels. (Cab and body are excluded.)
CIRCUIT (ELECTRIC)	a source of power
CLEARANCE	the space between two components
CLUTCH	a device used to connect or disconnect the power input to the power output
COMBUSTION	the act or process of burning
COMPRESSION	the process by which a confined gas is reduced in volume through the application of pressure
COOLANT	a liquid used as a cooling medium

COOLING SYSTEM	the complete system for circulating coolant
CORRODE	to eat or wear away gradually by chemical action
CYCLE	a series that repeats itself in the same sequence
CYLINDER	the piston chamber of an engine
CYLINDER HEAD	the replaceable portion of the engine that seals the cylinder at the top. It often contains the valves, and in some cases it is part of the combustion chamber
DEAD CENTER	either of two positions when the crank and connecting rod are in a straight line at the end of the stroke
DENSITY	the weight per unit volume of a substance
ENERGY	capacity for doing work
FIRING ORDER	the order in which the cylinders deliver their power stroke
FLYWHEEL	a device for storing energy in order to carry the piston over a compression and to minimize cyclical speed variations
FOUNDATION	the structure on which an engine is mounted
FOUR-STROKE CYCLE	cycle of events which is completed in four strokes of a piston, or in two crankshaft revolutions
FRAME	the main structural member of an engine
FRICTION	the resistance to motion due to the contact of two surfaces moving against each other
FUEL MIXTURE	a ratio of fuel and air
GASKET	a layer of material used between machined surfaces in order to seal them against leakage
GVW	abbreviation for gross vehicle weight. The total weight of a fully equipped vehicle and its load
HEAT	a form of energy
HORSEPOWER (HP)	a unit of power equivalent to 33,000 ft-lb of work per minute
HORSEPOWER (HP)	a unit of power equivalent to 33,000 ft-lb of work per minute
HYDRAULIC	the movement of liquids, or the force exerted by the movement of water, oil, or other liquids

IGNITION	the start of combustion
INJECTION SYSTEM	the components necessary for delivering fuel to the combustion chamber in the correct quantity, at the correct time, and in a condition satisfactory for efficient burning
INPUT	the amount of energy delivered to a machine
INSULATOR (ELECTRIC)	a material that, under normal conditions, will not conduct electricity
LINKAGE	a movable connection between two units
LPG	abbreviation for liquified petroleum gas; used as an engine fuel
LUBRICANT	a substance used to decrease the effects of friction, commonly a petroleum product (grease, oil, etc.)
MPH	abbreviation for velocity in miles per hour
NEWTON'S THIRD LAW	for every action there is an equal and opposite reaction
NONFERROUS METALS	any metal not containing iron
OHM	the metric unit of electric resistance
OUTPUT	the actual torque or energy delivered by a machine
PISTON	a cylindrical plug which slides up and down in the cylinder and which is connected to the connecting rod
PISTON DISPLACEMENT	the volume of air moved or displaced by a piston when moved from BDC to TDC
PLAY	the movement between two parts
PORTS	openings in the cylinder block and cylinder head for the passage of oil and coolant
PUMP	a device for moving fluids
REBORE	to bore out a cylinder to a size slightly larger than the original
RESISTOR	a device placed in a circuit to lower the voltage, reduce the current, or stabilize the voltage
RING JOB	service work on the piston and cylinder, including the installation of new piston rings

SAE	abbreviation for Society of Automotive Engineers
SAE HORSEPOWER (RATED HORSEPOWER)	formula to determine power: bore diameter^2 x number of cylinders/2.5 = hp
SHIM	thin, flat pieces of brass or steel used to increase the distance between two components
STROKE	one of a series of recurring movements of a piston or the distance of such a movement
STROKE-TO-BORE-RATIO	the length of stroke divided by the diameter of bore
TDC	abbreviation for "top dead center"
TOLERANCE	a fractional allowance for variations from specification
TORQUE	a force or combination of forces that produces a twisting or rotary motion
TRANSMISSION	a device used to transmit torque at various ratios and which can usually also change the direction of the force of rotation
TROUBLESHOOTING	the analyzing, testing, and measuring of an engine or other vehicle component to remedy any problems it may have in performing its function(s)
VOLT (V)	a unit of electromotive force that will move a current of 1 amp through a resistance of 1 ohm
VOLUME	the amount of space within a given confined area
WATT (W)	the metric measurement of power, equal to 0.00134 hp
WHEELBASE	the distance between the center of the front wheels and the center of the back wheels

TOOLS FOR DIESEL MECHANICS

Hand Tools

- Cold chisels
- Drills
- Files
- Hacksaws
- Hammers
- Pipe wrenches
- Pliers
- Punches
- Screwdriver
- Stud removers
- Torque wrenches
- Tubing cutters
- Wrenches

Measuring Tools

- Calipers
- Dial indicators
- Feeler gauges
- Micrometers
- Protractors
- Rulers
- Taps and Dies

Shop Tools

- Bench grinders and sanders
- Bench vise
- Clamps
- Grease guns
- Hydraulic jacks
- Hydraulic presses
- Impact wrenches
- Inspection mirrors
- Pullers and attachments
- Spring testers
- Steam cleaner

DIESEL MECHANICS

Math Skills

Count two-place numbers
Add two-place numbers
Subtract two-place numbers
Perform standard units of measurement, i.e., cup, pint, quart, inch, foot, yard, ounce, pound
Use basic measuring instruments, i.e., rulers, scales
Multiply two-place numbers
Divide two-place numbers
Add common fractions
Subtract common fractions
Multiply common fractions
Divide common fractions
Add two-place decimals
Subtract two-place decimals
Multiply two-place decimals
Divide two-place decimals
Add surface areas, values, weights and measures
Subtract surface areas, values, weights and measures
Multiply surface areas, values, weights and measures
Divide surface areas, values, weights and measures

NOTE: Many math books and workbooks provide needed direction in learning basic operations in math. This section assumes that students have basic skills and is designed to be used in conjunction with any of the math books you might be using, or to establish your own supplemental units. Any math practice activities should be developed within the context of the vocational program. Other persons to use as resources in this area include: parents, math teacher, and industrial arts teacher.

1. Review the activities for Small Engine Repair, Auto Mechanics and Welding for extra practice in math-related concepts.

2. Given a phone book, student will locate and count the number of businesses which sell and repair diesel equipment. A list of these should be kept for future reference.

3. Student will locate a newspaper advertisement for a discount on either diesel equipment repair or automobile repair. Student will figure the savings due to the discount. (He/she may need to call the business to determine the usual cost of the procedure).

4. Student will figure the gross monthly earnings of a diesel mechanic if paid the following amounts per hour: $3.35, $5.00, $7.50, $10.00, $15.50.

5. Student will locate items in the school (or home) which would be comparable to a cup, pint, quart and gallon.

6. Student will locate items in the school (or home) which weigh approximately an ounce, pound and ton.

7. Student will use a measuring tape and measure at least 5 items found in the classroom with 100% accuracy.

8. Given Worksheet DM #1, student will correctly answer 3 of 5 problems.

Answers to Worksheet DM #1

1. 4 amps
2. 2 ohms
3. 32 volts
4. 10 amps
5. 4 ohms

9. Given Worksheet DM #2, student will complete the math questions on volume, answering 8 out of 10 completely.

Answers to Worksheet DM #2

1. 339.12 cu. in.
2. 432 sq. ft.
3. 290,304 cu. in.
4. 12167 cu. ft.
5. 314 cu. in.
6. 108 sq. ft.
7. 11.343 cu. in.
8. 148.877 cu. in.
9. 171.16924 cu. in.
10. 31.944 cu. in.

SUGGESTIONS FOR PARENTS:

1. Student will complete an inventory list of items in a workshop area of the home and discuss with parents the need to restock any items.

2. Encourage student to read an automobile (or diesel truck) manual and be able to state the amount of fluid necessary for: oil, transmission, gasoline, antifreeze, etc.

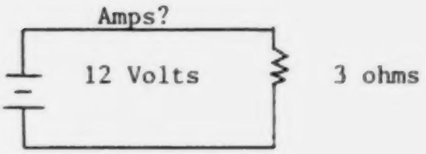
WORKSHEET

ELECTRICITY

Directions: The formula for Ohms law is E = I x R; where E = volts, I = amperes and R = ohms. Volts = amperes x ohms. The formula may need to be changed, depending upon the unknown in the problem. You will need to use one of these three formulas to solve the problems:

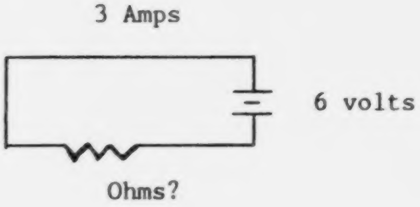
$E = I \times R$ $I = \frac{E}{R}$ $R = \frac{E}{I}$

1.


Amps?
12 Volts
3 ohms

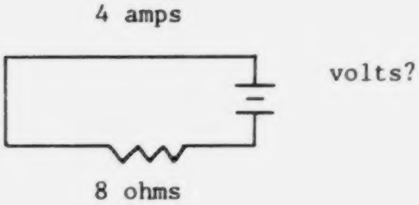
__________ amps

2.


3 Amps
6 volts
Ohms?

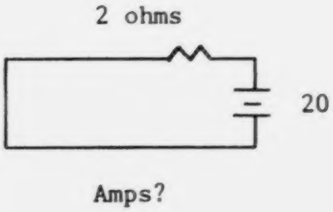
__________ ohms

3.


4 amps
volts?
8 ohms

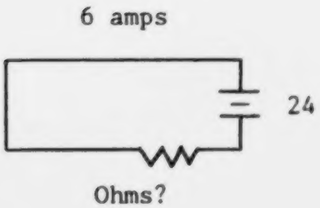
__________ volts

4.


2 ohms
20
Amps?

__________ amps

5.


6 amps
24
Ohms?

__________ ohms

DM #2

WORKSHEET

FORMULAS

DIRECTIONS: Study the examples of the formulas and choose the correct one to answer the problems.

Engine Displacement = Radius of bore^2 x 3.14 x stroke x number of cylinders

Engine Displacement = 1.5^2 x 3.14 x 4" x 4

= 2.25 x 3.14 x 4" x 4

= 113.04

Surface Area: AREA = LENGTH x WIDTH

Volume of a Cube : VOLUME = SIDE^3 (side length x side length x side length)

Volume of a Rectangle: VOLUME = LENGTH^2 x WIDTH x HEIGHT

1. A bore has a radius of 3", and a stroke of 2", and has 6 cylinders. What is the engine displacement? ____________ cu. in.

2. You are thinking of buying a shop building which measures 18' x 24': How much square footage would you have? ______________ sq. ft.

3. You need to fill a rectangular container with oil. The container is 24 in. long, 36 in. tall and 14 in. wide. How many cubic inches do you need to fill? ________________ cu. in.

4. How many cubic feet are in a cube which measures 23 ft. on one side? ________________ cu. ft.

5. A bore has a radius of 2.50, a stroke of 4" and 4 cylinders. What is the engine displacement? ________________ cu. in.

6. A flat bed trailer measures 18' long by 6'. How much square footage does it have? _______________ sq. ft.

7. A rectangle measures 2.75" long, 1.50" tall and 1" wide. How many cubic inches does it contain? _______________ sq in.

8. What is the volume of a cube whose side measures 5.3" ?___________ cu. in.

9. The stroke of an engine is 4.45", the radius of the bore is 1.75" and the number of cylinders is 4. What is the engine displacement? _______________ cu. in.

10. What is the volume of a rectangle which measures 2.2" by 1.5" by 4.4"? _______________ cu. in.

Physical Demands/Working Environment

Lift 100 lbs. maximum with frequent lifting and/or carrying of objects weighing up to 50 lbs. (heavy work)
Bend body downward and forward by bending the spine at the waist (stooping)
Bend legs at the knees to come to rest on the knee or knees (kneeling)
Bend body downward and forward by bending the legs and spine (crouching)
Move about on the hands and knees or hands and feet (crawling)
Extend the hands and arms in any direction (reaching)
Seize, hold, grasp, turn or otherwise work with the hand or hands (handling)
Pick, pinch, or otherwise work with the fingers (fingering)
Perceive size, shape, temperature or texture of objects and materials by using fingertips (feeling)
Ability to work inside
Ability to work in extreme noise, constant or intermittent, causing marked distraction or possible injury to hearing
Ability to work in extreme vibration, i.e., strain on body or extremities from repeated motion or shock

In most cases, the assessment of these skills will indicate that the student has the gross and fine motor skills which are prerequisites to learning the vocational skills in a Diesel Mechanics program. Prior to instruction in any physical demands activities, the student should have been evaluated and parents contacted to make sure that the student has no hidden physical problems that could be aggravated by lifting objects or by other physical activities done in this area. However, if the student has a physical disability or other limitation(s) preventing him/her from demonstrating fine and gross motor skills, then other techniques may be taught so he/she can perform in the vocational program. Other persons to use as resources in this area include: physical education teacher, industrial arts teacher, special education teacher, and parents.

1. After reviewing the instructional modules entitled "Physical Demand Movements," student will locate an object weighing 50 lbs., lift and carry it.

2. Student will identify as many visible parts to a car or diesel engine as possible. This will require student to open hood, bend into engine; squat or crouch to look under the vehicle for the exhaust system. Send student with someone knowledgeable (another student if possible) and have the student list all parts she/he is able to identify. The "expert" will state how well student performed. The vehicle's manual may also be of help in identifying major engine components.

3. Borrow (or bring from home) a set of socket wrenches and various screws. Student will arrange sockets from largest to smallest and identify the screws used with each size.

4. Visit an auto or diesel mechanic shop. Student will report on the working environment, tools seen, and types of vehicles being worked upon.

5. Obtain an old parts catalog. Student will locate pictures of common fasteners, seals and gaskets. Using a copy machine, student will copy the pictures and develop a notebook with the pictures and names.

SUGGESTIONS FOR PARENTS:

1. Student will identify an object around the home which weighs approximately 100 pounds. Help student lift the object, then see if she/he can lift it alone.

2. Allow student to fill gasoline tank, add oil, fill the windshield wiper fluid, etc., on the family car. Spilling around the area should be minimal.

DIESEL MECHANICS

Aptitudes - indicates an ability to:

Think visually of geometric forms (S-spatial)
Comprehend the two dimensional representation of three-dimensional objects (S-spatial)
Recognize the relationship resulting from the movements of objects in space (S-spatial)
Perceive pertinent detail in objects in pictorial or graphic material (P-form perception)
Make visual comparisons and discriminations and see slight differences (P-form perception)
Coordinate eyes and hands or fingers rapidly and accurately (K-motor coordination)
Make a movement response accurately and swiftly (K-motor coordination)
Move the fingers and manipulate small objects with the fingers, rapidly or accurately (F-finger dexterity)

1. Given an assortment of nuts and bolts, student will correctly assemble the right sizes by sight (rather than trial and error).

2. After practice of activity #1, time student on this activity.

3. Given Worksheet DM #3, student will match part names and write them correctly in the given blanks.

4. Given Worksheet DM #4, student will correctly read charts to answer the questions.

   Answers to Worksheet DM #4

   1. 1 m^2
   2. .2082 Imp. gal.
   3. 914.4 mm
   4. 1.057 U.S. quarts
   5. 1 inch
   6. 836,100 mm^2
   7. 27 ft^3
   8. .001 km
   9. 15.5 in^2
   10. 264.2 U.S. gallons

5. Student will draw a 3 dimensional picture, copying from one found in a magazine or book.

SUGGESTIONS FOR PARENTS:

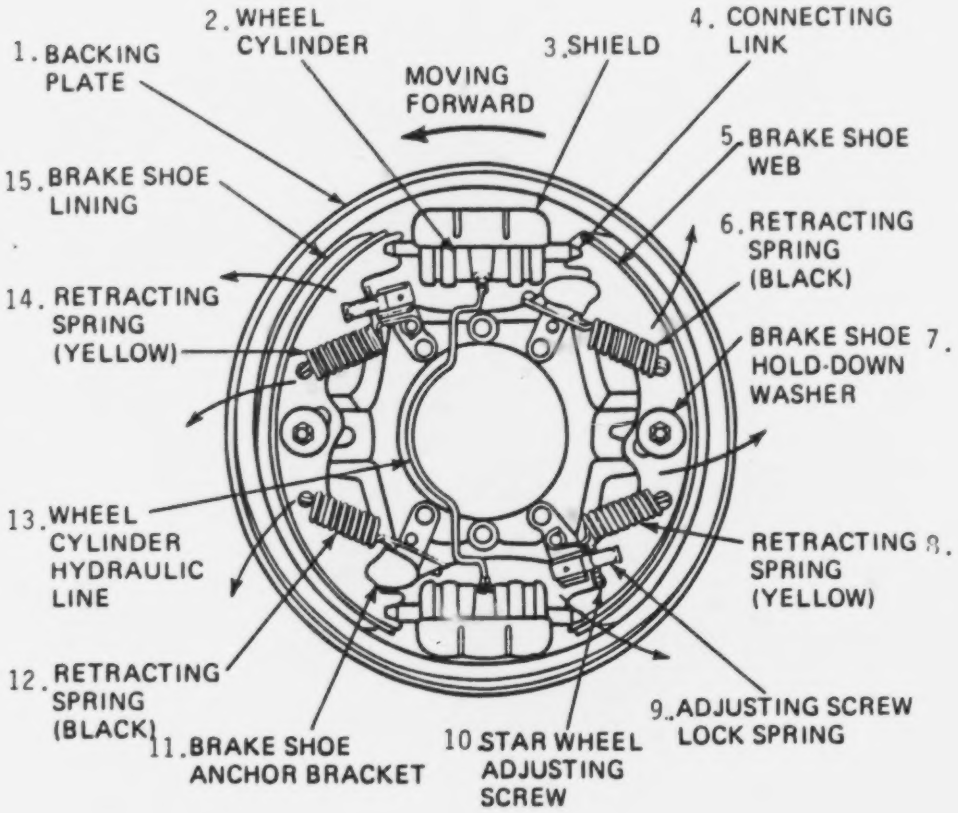
1. Encourage student to assemble models or help repair objects in the home.

2. Have student draw an "architect plan" for the home, using graph paper, to scale.

DM #3

WORKSHEET

DIRECTIONS: Below is a picture of a nonservo brake. Study it, then ask your teacher for the next worksheet. The picture is exactly like this one, but you will have to label it.


1. BACKING PLATE
2. WHEEL CYLINDER
MOVING FORWARD
3. SHIELD
4. CONNECTING LINK
5. BRAKE SHOE WEB
6. RETRACTING SPRING (BLACK)
7. BRAKE SHOE HOLD-DOWN WASHER
8. RETRACTING SPRING (YELLOW)
9. ADJUSTING SCREW LOCK SPRING
10 STAR WHEEL ADJUSTING SCREW
11. BRAKE SHOE ANCHOR BRACKET
12. RETRACTING SPRING (BLACK)
13. WHEEL CYLINDER HYDRAULIC LINE
14. RETRACTING SPRING (YELLOW)
15. BRAKE SHOE LINING

WORKSHEET

DIRECTIONS: Fill in the blanks by labeling the parts missing.

1. ______________ ________

2. ____________ ____________

3. ____________

4. ____________________ ________

5. ___________ _________ ________

6. ____________________ ______________

7. ___________ ________ ____________________ ___________

8. ________________ ____________

9. ______________ _________ ________ __________

10. ______ ________ ____________ ____________

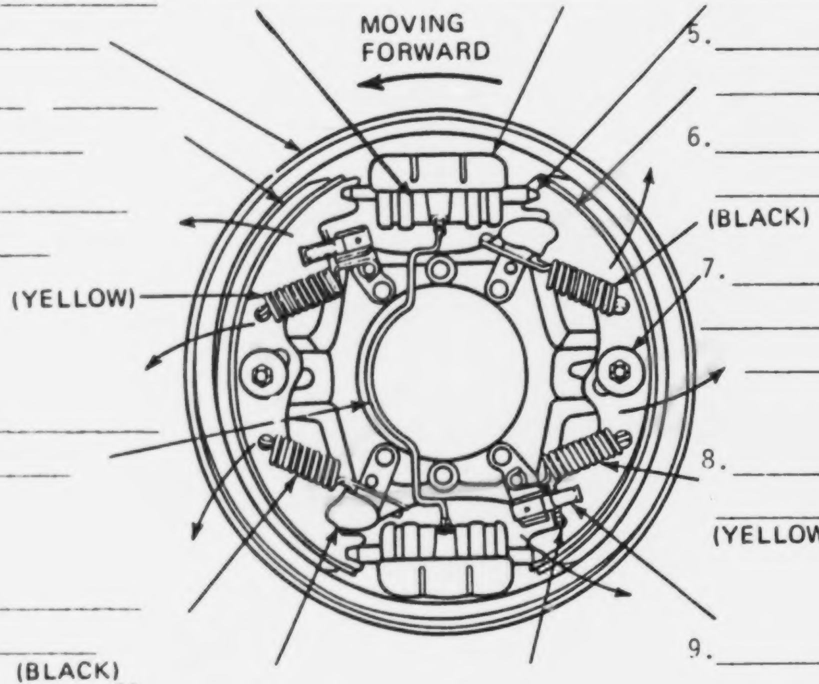
11. ________ _____ __________ __________

12. ____________ __________

13. ___________ ____________ ______________________ ___________

14. _________________ ___________

15. ___________ _______ _____________


MOVING FORWARD
(YELLOW)
(BLACK)
(YELLOW)
(BLACK)

DM #4

WORKSHEET

CHART READING

AREA

	in^2	ft^2	yd^2	mm^2	cm^2	dm^2	m^2
1 in^2 =	—	0.0069		645.2	6.452	0.06452	0.00064
1 ft^2 =	144	—	0.1111	92,903	929	9.29	0.0929
1 yd^2 =	1296	9	—	836,100	8361	83.61	0.8361
1 mm^2 =	0.0015			—	0.01	0.0001	0.000001
1 cm^2 =	0.155	0.0017		100	—	0.01	0.0001
1 dm^2 =	15.5	0.1076	0.01196	10,000	100	—	0.01
1 m^2 =	1550	10.76	1.196	1,000,000	10,000	100	—

CAPACITY AND VOLUME

	in^3	ft^3	U.S. qt	U.S. gal	Imp. gal	cm^3	dm^3	m^3
1 in^3 =	—		0.01732			16.39	0.01639	
1 ft^3 =	1728	—	29.92	7.481	6.229		28.32	0.02832
1 yd^3 =	46,656	27	807.9	202	168.2		764.6	0.7646
1 U.S. qt =	57.75	0.03342	—	0.25	0.2082	946.4	0.9464	
1 U.S. gal =	231	0.1337	4	—	0.8327	3785	3.785	0.003785
1 Imp. gal =	277.4	0.1605	4.804	1.201	—	4546	4.546	0.004546
1 cm^3 =	0.06102	0.003	0.105	0.0264	0.022	—	0.001	0.000001
1 dm^3 =	61.02	0.03531	1.057	0.2642	0.22	1000	—	0.001
1 m^3 =	61,023	35.31	1057	264.2	220		1000	—

LENGTH

	in	ft	yd	mm	cm	m	km
1 in =	—	0.08333	0.02778	25.4	2.54	0.0254	
1 ft =	12	—	0.3333	304.8	30.48	0.30488	
1 yd =	36	3	—	914.4	914.4	0.9144	
1 mm =	0.03937	0.003281		—	0.1	0.001	
1 cm =	0.3937	0.03281	0.01094	10	—	100	
1 m =	39.37	3.281	1.094	1000	100	—	0.001
1 km =	39,370	3281	1093.6	10^6	100,000	1000	—

WORKSHEET

CHART READING

DIRECTIONS: Answer the questions by using the correct conversion charts on the following page.

1. How many m^2 are there in 10,000 cm^2? ______________
2. One U.S. quart equals how many Imp. gallons? ______________
3. One yard is how many mm? ______________
4. One dm^3 is equal to ______________ U.S. quarts.
5. 2.54 cm is equal to ______________ inches.
6. .8361 m^2 is equal to ______________ mm^2.
7. One $yard^3$ is equal to ______________ ft^3.
8. One m is equal to how many km? ______________
9. One dm^2 is equal to ______________ in^2.
10. One m^3 is equal to ______________ U.S. gallons.

DIESEL MECHANICS

Temperament - indicates an ability to adapt to:

Making generalizations, evaluations, or decisions based on measurable or verifiable criteria
Situations requiring the precise attainment of set limits, tolerances, or standards
Performing a variety of duties, often changing from one task to another of a different nature without loss of efficiency or composure

1. Given a hypothetical essay question, student will develop a set of measurable criteria on which to judge a grade for the essay question.

2. Student will collect price information on several different brands of diesel equipment (trucks, bulldozers, tractors, etc.). Student will then list the advantages and disadvantages of each, and decide which is the best buy. (This could also be assigned as a research paper).

3. Student will choose an object in the room and measure it accurately to the 1/16 of an inch.

4. Student will state the grading scale for the class (i.e., 90-100 = A) and figure his/her grade according to this standard.

5. After being told of the purpose of this task, student will be asked to begin new tasks, interrupting current tasks at certain times, and demonstrate ability to change tasks easily.

6. Student will agree to perform tasks over until the standards set by the teacher are met.

SUGGESTIONS FOR PARENTS:

1. Require student to list the standards required for chores assigned and to re-do the chores until the standards are met.

2. Have student discuss and justify his/her desires to become a diesel mechanic (i.e., how did he/she come to this decision?).

DIESEL MECHANICS

Vocational

Identify basic hand tools and equipment
Use basic hand tools and equipment
Demonstrate knowledge of basic safety concepts

1. Given an old catalog, or a visit to a diesel mechanic shop, student will identify as many tools on the tool list as possible.

2. Obtain an outside opinion from parents or industrial arts teacher on student's ability to use tools and student's safety awareness.

3. Have student list as many safety precautions as possible and compare the list with Worksheet DM #5.

SUGGESTIONS FOR PARENTS:

1. Encourage use of hand tools and equipment. Provide supervision and instruction as necessary.

2. Visit a hardware store and spend time identifying tools and explaining their uses. (Have student ask a salesperson if a tool or its use is unknown).

3. Allow student to perform a safety inspection of the home and report any problems encountered.

WORKSHEET

SAFETY RULES

1. Know where the fire alarms are located.
2. Know where the different fire extinguishers are located.
3. Know how to operate the different types of fire extinguishers.
4. Keep all flammable fluid and material in a safe container and whenever possible store them in a separate area.
5. Keep your workshop clean and immediately discard all rubbish and combustibles. Dispose of oily rags as soon as you are finished with them by placing them in a covered steel container.
6. Keep all solvent tanks tightly covered when they are not being used.
7. Use solvent as a cleaning fluid; do not use gasoline or carbon tetrachloride.
8. Make certain that all electrical equipment is properly connected and grounded.
9. Make certain that the lamp guard is in place when using an extension light. Lamp breakage near accumulated oil or fuel may cause a fire.
10. Make certain that you have a fire extinguisher within reach when using a torch of any kind and always keep your attention on the flame.
11. Never point the flame toward yourself or others and never rest a flaming torch on an object. Shut the torch off immediately after using it.
12. Do not enter a room marked "No Smoking" with an open flame.
13. Do not flip a match or cigarette in any direction before you are certain it is extinguished.
14. Do not approach a battery that is being charged with an open flame or lighted cigarette, since the charging gases are highly explosive.
15. Do not connect the charger cables to the battery when the charger is switched on, or an explosion may result.
16. Disconnect the battery ground cable first when removing batteries; when reconnecting the batteries, connect the ground cable last.
17. Connect the ground cable of the booster battery to the engine and not to the vehicle battery when boost-starting an engine.

18. Do not leave a soldering iron or heating device plugged in after you have finished with it. Left unattended, these devices could overheat and cause a fire.

19. Keep your mind on your work. If you daydream or allow your personal problems to divide your attention you become an easy mark for an accident.

20. Do not wear an open jacket or shirt when coveralls should be worn. They could get caught in a machine or vehicle and cause injury to the wearer.

21. Do not wear unclean coveralls. They should be free of oil, grease, or fuel to prevent skin irritation or severe burns if a spark should ignite them.

22. Do not wear any type of jewelry. Neck jewelry can get caught in machinery and rings can get hooked on a corner ledge, bolt, etc.

23. Never take chances or shortcuts.

24. Always block the vehicle or equipment before removing a wheel or hydraulic cylinder.

25. Carefully select the blocking material or tool to conform to the weight, size, and other specifications of the vehicle.

26. Check the service manual for specifications, torque, etc. (do not guess).

27. On completion of the job, recheck to make certain that you have not forgotten to tighten a cap screw, nut, fitting, etc., and that, when necessary, they have been secured with a cotter pin, lockwire, or lockplate.

RESOURCES

DIESEL MECHANICS

John Deere Service Publications
Dept. F
John Deere Road
Moline, IL 61265

- Fundamentals of Service: Hydraulics
- Fundamentals of Service: Engines
- Fundamentals of Service: Electrical Systems
- Fundamentals of Service: Bearings and Seals
- Fundamentals of Service: Shop Tools

McGraw Hill
13955 Manchester Road
Manchester, MO 63011

- Diesel Mechanics, Schulz, E. J.
- Diesel Equipment I, Schulz, E. J.

Howard W. Sams & Co., Inc.
4300 W. 62nd St.
Indianapolis, IN 46268

- Diesel Engine Maintenance, Maclean, D. S.

Instructional Materials Laboratory
908 Woodson Way
University of Missouri-Columbia
Columbia, MO 65211

- Basic Hydraulics
- Pneumatics
- Micrometers, Calipers and Gauges
- Torque and Torque Wrenches
- Power Tool Safety and Operation
- Diesel Mechanics

MACHINIST

Sample Occupational Areas:
Machinist Apprentice
Machinist Apprentice, Outside
Machinist, Bench
Machinist, General
Machinist Helper, Marine

Introduction

Knowledge of math and precision measurement tools are major areas in the machinist trades. Students interested in this area should be able to use formulas comfortably and preferably have taken an algebra course successfully. Of course, some machinist jobs require higher math skills than others, but students should understand that computation is a large part of this trade area.

Math classes and industrial arts classes, especially in metal working, would be excellent preparation for this vocational class. Students should have an eye for detail, precision working and excellent coordination, as some machines require foot manipulation as well as eye-hand coordination in guiding metal through the machine. Good safety habits are also important.

VIMS COMPETENCIES FOR MACHINIST

A. Orientation to Machine Shop

1. Operate safely in the workshop
2. List machine shop safety rules and regulations
3. Identify characteristics of a machinist
4. Inspect work area for safe work environment

Other (specify):

B. Performing Mathematical Calculations

1. Convert common fraction to decimal fraction and vice versa
2. Calculate tap drill size with formula and charts
3. Convert customary measurements to metric and vice versa
4. Use calculator to perform mathematical operations
5. Calculate amount of stock required
6. Calculate part and feature dimensions and locations
7. Convert revolutions per minute (RPM) to surface feet per minute (SFPM)
8. Calculate feeds and speeds
9. Calculate tapers for machine set-up
10. Calculate sine bar set-up
11. Perform angular and simple indexing calculations
12. Calculate measurements of right triangles
13. Calculate plane geometry/math applications

Other (specify):

C. Performing Precision Measurement

1. Care for precision instruments
2. Measure workpiece with tape measure
3. Measure workpiece with pocket rule
4. Measure workpiece with slide caliper rule
5. Lay out work with combination square
6. Transfer measurement with dividers
7. Lay out workpiece with hermaphrodite calipers
8. Measure workpiece with spring calipers
9. Measure workpiece with vernier calipers
10. Measure workpiece with depth gages
11. Measure workpiece with micrometers
12. Measure workpiece with dial calipers
13. Measure workpiece with telescope and hole gages
14. Check work with gages, i.e., plug and ring gages
15. Measure workpiece with height gages
16. Lay out workpiece and measure on surface plate
17. Measure workpiece on surface plate
18. Measure workpiece with gage blocks
19. Measure workpiece with dial indicators and attachments
20. Measure workpiece with thread wires and micrometers
21. Check and/or lay out workpiece with sine bar

Other (specify):

D. Blueprint Reading

1. Interpret meaning of common drafting symbols
2. Interpret blueprint
3. Make a sketch from a finished workpiece
4. Calculate tolerances and allowances
5. Calculate missing dimensions
6. Use geometric dimensioning and tolerancing
7. Use machinist's handbook to plan work
8. Lay out a part based on blueprint information
9. Play sequence of machining operations

Other (specify):

E. Performing Bench Work

1. Use and care for hand tools
2. Cut materials with hand hack saw
3. Bench file/deburr workpiece
4. Mark locations with prick and center punches
5. Locate holes with transfer screws and transfer punches
6. Cut threads with die
7. Cut threads with hand tap
8. Ream holes with hand reamer
9. Dress and true grinding wheels on on pedestal/bench grinder
10. Grind and shape tools on pedestal/bench grinder
11. Use abrasives/whetting/polishing/lapping
12. Grind using appropriate hand grinder
13. Remove damaged screws
14. Remove broken drills and taps
15. Remove and install dowell pins
16. Install a helical coil thread insert
17. Straighten workpiece on arbor press
18. Assemble and disassemble workpiece with arbor press
19. Broach workpiece with broaching tool
20. Assemble and disassemble precision parts

Other (specify):

F. Introduction to Material Science

1. Identify types of metals and related materials
2. List properties that affect machinability
3. Correlate types of materials to their properties
4. List major cutting tool variables

5. Perform heat treatment process
6. Test workpiece for hardness without hardness tester

Other (specify):

G. Operating Power Saws

1. Employ power saw safety guidelines consistently
2. Perform care and maintenance
3. Select proper blade type for sawing operations and materials
4. Cut and weld band saw blades
5. Select and set speeds and feeds on power saw
6. Cut material to length with power hack saw
7. Cut material to length with band saw
8. Select and apply cutting fluids
9. Contour saw to scribed line
10. Saw internal contours with band saw

Other (specify):

H. Operating Drill Presses

1. Employ drill press safety guidelines consistently
2. Perform care and maintenance
3. Set up and clamp workpiece to drill press table
4. Select proper drill type based on job requirements
5. Determine cutting tool variables prior to use
6. Set up drill press to obtain calculated feeds and speeds
7. Select and apply cutting fluids
8. Drill holes to specification using manual feed
9. Drill holes to specification using automatic feed
10. Countersink hole to specifications
11. Counterbore hole to specifications
12. Spotface to specific dimensions
13. Mount workpiece on V-blocks
14. Power ream hole to size
15. Use drill jigs and bushings
16. Hand tap hole using drill press
17. Tap hole with tapping attachments
18. Sharpen drills with grinding attachments and/or specialized grinders
19. Set up radial drill press

Other (specify):

I. Operating Lathes

1. Employ lathe safety guidelines consistently
2. Perform care and maintenance
3. Align lathe centers using test bar and dial indicators
4. Determine cutting tool variables prior to use
5. Calculate feeds and speeds and set up lathe accordingly
6. Select and apply cutting fluids
7. Face workpiece between centers
8. Set up tooling
9. Turn workpiece between centers
10. Center workpiece in four-jaw chuck
11. Drill holes
12. Ream holes
13. Bore holes
14. Countersink holes
15. Counterbore holes
16. Knurl parts
17. Cut/chase external threads
18. Chase/rechase internal threads
19. Chase metric threads
20. Use compound rest to cut short external tapered surface
21. Cut tapers by offset tailstock
22. Cut an external tapered surface with taper attachment
23. Cut internal tapered surface with taper attachment
24. Align workpiece on faceplate
25. Perform lathe filing
26. Polish workpiece
27. Turn or thread long workpieces using follower and steady rest
28. Cut multiple threads
29. Cut ACME threads
30. Use form tooling
31. Use mandrel

Other (specify):

J. Operating Milling Machines

1. Employ milling machine safety guidelines consistently
2. Perform care and maintenance
3. Align mill head to table
4. Align milling machine attachments
5. Align workpiece mounted on machine table
6. Calculate proper feeds and speeds and set up mill accordingly
7. Select and apply proper cutting fluids
8. Determine cutting tool variables prior to use
9. Square workpiece using table vise
10. Mill workpiece with end mill
11. Locate work with edge finder
12. Drill holes with milling machine
13. Ream holes
14. Bore holes with milling machine
15. Form mill workpiece
16. Machine workpiece mounted on V-blocks
17. Machine external straight keyway
18. Machine woodruff keyway
19. Mill angular surfaces
20. Mill an external radius with rotary table
21. Mill an internal radius with rotary table
22. Mill workpiece using simple indexing operation
23. Use ditigal readout
24. Machine workpiece by straddle milling

25. Perform gang milling
26. Perform gear cutting operations
Other (specify):
____
____
____

K. Operating Grinders

1. Employ grinder safety guidelines consistently
2. Clean and lubricate grinders
3. Inspect grinding wheel
4. Balance grinding wheel
5. Select and mount grinding wheel
6. Dress and true machine tool grinding wheel
7. Calculate feeds and speeds and set up machine accordingly
8. Select and apply cutting fluids
9. Grind workpiece on magnetic chuck using power feed
10. Grind workpiece square on surface grinder
11. Indicate workpiece to be ground
12. Grind angular surfaces
13. Grind workpiece between centers
Other (specify):
____
____
____

L. Tool and Cutter Grinding

1. Employ safety guidelines
2. Perform care and maintenance
3. Inspect grinding wheels
4. Select and mount grinding wheel
5. Dress and true grinding wheel
6. Set up machine
7. Sharpen cutters on tool and cutter grinders
Other (specify):
____
____
____

M. Concepts of Numerical Controlled Machines

1. Employ numerical controlled machine safety guidelines consistently
2. Perform care and maintenance
3. Calculate coordinates and dimensions of numerical control drawing
4. Write program for numerical control machine
5. Set up a numerical control machine
6. Machine workpiece with numerical control machine
Other (specify):
____
____
____

Leadership Competencies **

1. Demonstrate an understanding of VICA, its structure and activities
2. Demonstrate an understanding of one's personal values
3. Perform tasks related to effective management skills
4. Demonstrate interpersonal skills
5. Demonstrate etiquette and courtesy
6. Demonstrate effectiveness in oral and written communications
7. Develop and maintain a code of professional ethics
8. Maintain a good professional appearance
9. Perform basic tasks related to securing and terminating employment
10. Perform basic parliamentary procedures in a group meeting

** (Note: These competencies are addressed in the Missouri VICA Curriculum Guide lessons.)

MACHINIST
ACCESS SKILLS CHECKLIST

Student Name/ID ______________________ Sending School ______________________

Instructor ______________________ Date(s) Evaluated ______________________

Circle proper mastery code: 3 = MASTERY 2 = REQUIRES SUPERVISION
1 = NOT MASTERED N or blank = NO EXPOSURE

TASK DESCRIPTION	TASK ID #	MASTERY CODE	MASTERY DATE	RETRY CODE/DATE
1. Count two-place numbers	480598A001	3 2 1 N		
2. Add two-place numbers	480598A002	3 2 1 N		
3. Subtract two-place numbers	480598A003	3 2 1 N		
4. Perform standard units of measurement, i.e., cup, pint, quart, inch, foot, yard, ounce, pound	480598A004	3 2 1 N		
5. Use basic measuring instruments, i.e., rulers, scales	480598A005	3 2 1 N		
6. Multiply two-place numbers	480598A006	3 2 1 N		
7. Divide two-place numbers	480598A007	3 2 1 N		
8. Add common fractions	480598A008	3 2 1 N		
9. Subtract common fractions	480598A009	3 2 1 N		
10. Multiply common fractions	480598A010	3 2 1 N		
11. Divide common fractions	480598A011	3 2 1 N		
12. Add two-place decimals	480598A012	3 2 1 N		
13. Subtract two-place decimals	480598A013	3 2 1 N		
14. Multiply two-place decimals	480598A014	3 2 1 N		
15. Divide two-place decimals	480598A015	3 2 1 N		
16. Add surface areas, values, weights and measures	480598A016	3 2 1 N		
17. Subtract surface areas, values, weights and measures	480598A017	3 2 1 N		
18. Multiply surface areas, values, weights and measures	480598A018	3 2 1 N		
19. Divide surface areas, values, weights and measures	480598A019	3 2 1 N		
20. Lift 50 lbs. maximum with frequent lifting and/or carrying of objects weighing up to 25 lbs. (Medium work)	480598B001	3 2 1 N		
21. Bend body downward and forward by bending the spine at the waist (stooping)	480598B002	3 2 1 N		
22. Bend legs at the knees to come to rest on the knee or knees (kneeling)	480598B003	3 2 1 N		
23. Bend body downward and forward by bending the legs and spine (crouching)	480598B004	3 2 1 N		
24. Move about on the hands and knees or hands and feet (crawling)	480598B005	3 2 1 N		

MACHINIST
ACCESS SKILLS CHECKLIST

Student Name/ID ______________________ Sending School ______________________

Instructor ______________________ Date(s) Evaluated ______________________

Circle proper mastery code: 3 = MASTERY 2 = REQUIRES SUPERVISION
1 = NOT MASTERED N or blank = NO EXPOSURE

TASK DESCRIPTION	TASK ID #	MASTERY CODE	MASTERY DATE	RETRY CODE/DATE
25. Extend the hands and arms in any direction (reaching)	480598B006	3 2 1 N		
26. Seize, hold, grasp, turn or otherwise work with the hand or hands (handling)	480598B007	3 2 1 N		
27. Pick, pinch, or otherwise work with the fingers (fingering)	480598B008	3 2 1 N		
28. Perceive size, shape, temperature or texture of objects and materials by using fingertips (feeling)	480598B009	3 2 1 N		
29. Ability to work inside	480598B010	3 2 1 N		
30. Ability to work in extreme noise, constant or intermittent, causing marked distraction or possibly injury to hearing	480598B011	3 2 1 N		
31. Ability to work in extreme vibration, i.e., strain on body or extremities from repeated motion or shock	480598B012	3 2 1 N		
32. Coordinate eyes and hands or fingers rapidly and accurately (K-motor coordination)	480598C001	3 2 1 N		
33. Make a movement response accurately and swiftly (K-motor coordination)	480598C002	3 2 1 N		
34. Making generalizations, evaluations, or decisions based on sensory or judgmental criteria	480598D001	3 2 1 N		
35. Situations requiring the precise attainment of set limits, tolerances, or standards	480598D002	3 2 1 N		
36. Identify basic hand tools and equipment	480598E001	3 2 1 N		
37. Use basic hand tools and equipment	480598E002	3 2 1 N		
38. Demonstrate knowledge of basic safety concepts	480598E003	3 2 1 N		

MACHINIST VOCABULARY

ABRASIVE BAND	a band used for polishing a previously file finished surface
ABRASIVE MACHINING	the faster removal of material to a specified finish and dimensional sizes, shapes, and tolerances than by using conventional cutting tools
ANNEALING	heating and cooling metals for purposes of softening, removing internal stresses, or altering mechanical or physical properties
BASELINE DIMENSIONING	successive measurements that originate from one or more common finished surfaces
BILATERAL TOLERANCE	a two-direction tolerance. A tolerance above (+) and below (-) a basic dimension
CASEHARDENING	a series of heat-treating processes to produce a hardenable outer case
CLASSES OF FIT (HOLES)	standards accepted by manufacturers, designers, and engineers for mating parts
CLIMB (DOWN) MILLING	a machine cutting technique. Feeding a workpiece in the same direction that the milling cutter rotates
CONTINUOUS-PATH SYSTEM (CONTOUR CONTROL)	the continuous and independent control of two or more instantaneous tool motions
COORDINATE CHART	a table accompanying a part drawing. A table that gives dimensions to locate each feature with respect to zero coordinates. (The chart contains other feature specifications)
CRITICAL POINTS OF STEEL	upper and lower temperatures affecting hardness and other properties of steels
DIGITAL INPUT DATA	pulses, digits, or other coding elements that supply information to a machine control
DIMENSIONAL STABILITY PRECISION INSTRUMENTS	the ability of an instrument to provide the same precise measurements over a long period of time
DIMENSIONAL TOLERANCE	the permissable variation of a workpiece from its nominal dimension
DISCONTINUOUS SURFACE	a plane surface that is interrupted by a slot, groove, ridge, hole, or other cutaway section

FLOOD, THROUGH-THE-WHEEL, AND MIST COOLING SYSTEMS	three basic grinding machine coolant systems
FRICTION SAWING	a sawing process where heat is instantly generated ahead of the saw teeth
GAGE BLOCKS	hardened, precision-ground and finished rectangular steel blocks used to lay out work and make measurements
HARDENABILITY, MACHINABILITY, DUCTILITY	physical properties of industrial manufacturing and cutting tools. Factors to consider in selecting material for a workpiece or a cutting tool
HARDENING TEMPERATURE	the temperature at which a steel part is heated or soaked before quenching
INTERNATIONAL (ISO) METRIC THREAD SYSTEM	a metric thread system accepted as an international standard
MAGNESIUM, CHROMIUM, MOLYBDENUM, TUNGSTEN, AND COBALT	metal elements added to steel to form alloys that possess specific properties. Metal elements that increase physical properties of steels and alloys such as wear resistance, toughness, red hardness and hardenability
QUALITY CONTROL	techniques and measurement systems used in manufacturing to ensure conformity with standards
RATE OF FEED (ipm or mm/min)	the distance a workpiece feeds into a cutter in one minute
RATE OF FEED (i^{3}pm)	the volume (mass) of material removed in one minute. The number of cubic inches of material machined in one minute
SYNTHETIC CUTTING FLUIDS	a mixture of chemical additives that improve the wetting and cooling properties of water
TEMPERING	a transformation temperature range below which a hardened or normalized steel part is reheated, followed by cooling at a specified rate
ZERO COORDINATE	a starting point from which all dimensions along a specific axis originate. A fixed reference point for all dimensions on a plane line

MACHINIST TOOL LIST

Measuring Tools

- Caliper
- Fixed gages
- Gage blocks
- Micrometer
- Protractors
- Sine Bar
- Squares
- Steel rulers

Hand Tools

- Hacksaw and Files
- Hammers
- Metal stamps
- Pliers
- Reamers
- Screwdrivers
- Taps and Dies
- Wrenches

Layout Tools

- Angle plates
- C-clamps
- Center punch
- Combination bit
- Divider
- Parallels
- Prick punch
- Scriber
- V-blocks

Power Tools

- Contour bandsaws
- Drill presses
- Grinders
- Horizontal bandsaws
- Lathes
- Milling machines
- Shapers

MACHINIST

Math Skills

Count two-place numbers
Add two-place numbers
Subtract two-place numbers
Perform standard units of measurement, i.e., cup, pint, quart, inch, foot, yard, ounce, pound
Use basic measuring instruments, i.e., rulers, scales
Multiply two-place numbers
Divide two-place numbers
Add common fractions
Subtract common fractions
Multiply common fractions
Divide common fractions
Add two-place decimals
Subtract two-place decimals
Multiply two-place decimals
Divide two-place decimals
Add surface areas, weights and measures
Subtract surface areas, weights and measures
Multiply surface areas, weights and measures
Divide surface areas, weights and measures

NOTE: Many math books and workbooks provide needed direction in learning basic operations in math. This section assumes that students have basic skills and is designed to be used in conjunction with any of the math books you might be using, or to establish your own supplemental units. Any math practice activities should be developed within the context of the vocational program. Other persons to use as resources in this area include: parents, math teacher, and industrial arts teacher.

1. Given a teacher-developed worksheet containing 20 different lengths of a straight line, student will accurately measure each line using a ruler. (Line lengths should range from full numbers to using 16ths or 32nds of an inch).

2. Given a worksheet of unlike fractions (teacher made or from a workbook), student will accurately answer at least 80% of the problems. (Worksheets for addition, subtraction, multiplication and division should be available).

3. Given Worksheet M #1, student will compute problems with 90% accuracy.

   Answers to Worksheet M #1:

   1. \$20.50
   2. 42.5 lbs.
   3. \$41.40
   4. 216.84 lbs.
   5. 111 lbs.
   6. 2 ft.
   7. 94.5 ¢
   8. 500 ft.

4. Given Worksheet M #2, student will complete the problems using the area and volume formulas.

   Area = length x width $A = L x W$
   Volume for cube = $V = S^3$ (S=side)

Volume for rectangle = $V = L \times W \times h$ (h=height)
Volume for square = $V = S^2 \times h$

Answers to Worksheet M #2:

1. 50 sq. in.
2. 27 cu. in.
3. 2000 cu. in.
4. 1848 cu. in.
5. 1152 cu. ft.
6. Check drawing, 6 sq. in.
7. 800 sq. ft.
8. 8000 cu. ft.
9. 941.192 cu. in.
10. 845.25 cu. in.

5. Given Worksheet M #3, student will use chart to answer the questions.

Answers to Worksheet M #3:

1. .4375
2. 25/64
3. 1.0000
4. 3/4
5. .3750
6. 7/32
7. .3438
8. 1/4
9. .9375
10. 31/64

6. After studying Worksheet M #3, student will memorize and be able to state the following fractions in decimals or vice versa.

1/4 (.2500)
5/16 (.3125)
3/8 (.3750)
7/16 (.4375)
1/2 (.5000)
9/16 (.5625)
5/8 (.6250)
3/4 (.7500)
7/8 (.8750)

7. Student will demonstrate ability to utilize all functions of a calculator efficiently.

SUGGESTIONS FOR PARENTS:

1. Encourage student to use math skills whenever possible (i.e., figuring cost of groceries, measuring room for new carpet, figuring amount of lumber for a project, etc.)

2. Encourage student to practice all the functions on a calculator.

WORKSHEET

DIRECTIONS: Using the chart below, answer the questions. You may need some scratch paper.

WEIGHTS AND LIST PRICES OF BLACK BAND IRON

Size	Wt. per Ft. (lb.)	List Price Per 100 Ft.
1/2 in. x 12-gage	.185	$ 20.70
3/4 in. x 12-gage	.278	19.70
1/2 in. x 1/8 in.	.212	20.50
3/4 in. x 1/8 in.	.318	19.50
1 in. x 1/8 in.	.425	19.10
1 1/2 in. x 1/8 in.	.6375	19.00
3/4 in. x 3/16 in.	.478	19.40
1 1/2 in. x 3/16 in.	.956	18.90

1. What is the cost of 100 feet of 1/2 in. x 1/8 in. black band iron?

   $ ____________________

2. What is the weight of 100 feet of 1 in. x 1/8 in. black band iron?

   ____________________ lbs.

3. What is the price of 200 feet of 1/2 in. x 12 gage black band iron?

   $ ____________________

4. What is the weight of 780 feet of black band iron, size 3/4 in. x 12 gage?

   ____________________ lbs.

5. Find the weight of 600 feet of black band iron, 1/2 in. x 12 gage.

   ____________________ lbs.

6. If a 3/4 in. x 1/8 in. of black band iron weighs .636 lbs., how many feet are there?

   ____________________ ft.

7. What is the cost of 5 feet of 1 1/2 in. x 3/16 in. black band iron?

   $ ____________________

8. An order of 1 1/2 in. x 1/8 in. black band iron has come in with a bill for $95.00. How many feet were purchased?

   ____________________ ft.

WORKSHEET

AREA AND VOLUME

DIRECTIONS: Choose the correct formula and solve the following problems.

AREA = LENGTH X WIDTH

VOLUME = LENGTH X WIDTH X HEIGHT (rectangle)

VOLUME = SIDE^3 (cube)

VOLUME = SIDE^2 X HEIGHT (square prism)

1. What is the area of a piece of metal 10" long and 5" wide?

_________________________square inches

2. The side of a cube is 3". What is its volume?

_________________________cubic inches

3. The length of each side of a container is 10" and its height is 20". What is its volume?

_________________________cubic inches

4. The length of a rectangle is 22", the width is 14", and the height is 6". What is its volume?

_________________________cubic inches

5. Find the volume of a square room in cubic feet if the length is 12' and the height is 8'.

_________________________cubic feet

6. Draw a rectangle 3" x 2" and figure the area in square inches.

_________________________square inches

7. What is the area of a shop floor if the shop measures 20' by 40'?

_________________________square feet

8. What is the volume of the shop if the length is 20', the width is 40', and the height is 10'?

_________________________cubic feet

9. What is the volume of a cubic container whose sides measure 9.8"?

_________________________cubic inches

10. What is the volume of a square prism whose side measures 3.5" and whose height measures 6.9"?

_________________________cubic inches

M #3

Worksheet

FRACTION/DECIMAL CONVERSION

Conversion Chart

Decimal	Inch	mm	Decimal	Inch	mm	Decimal	Inch	mm	Decimal	Inch	mm
.2040			.2854		7.25	.3740		9.50	.6496		16.50
.2047		5.20	.2874		7.30	.3750	3/8		.6562	21/32	
.2055			.2900			.3770			.6693		17.00
.2067		5.25	.2913		7.40	.3780		9.60	.6719	43/64	
.2087		5.30	.2950			.3819		9.70	.6875	11/16	
.2090			.2953		7.50	.3839		9.75	.6890		17.50
.2126		5.40	.2969	19/64		.3858		9.80	.7031	45/64	
.2130			.2992		7.60	.3860			.7087		18.00
.2165		5.50	.3020			.3898		9.90	.7188	23/32	
.2188	7/32		.3032		7.70	.3906	25/64		.7283		18.50
.2205		5.60	.3051		7.75	.3937		10.00	.7344	47/64	
.2210			.3071		7.80	.3970			.7480		19.00
.2244		5.70	.3110		7.90	.4040			.7500	3/4	
.2264		5.75	.3125	5/16		.4062	13/32		.7656	49/64	
.2280			.3150		8.00	.4130			.7677		19.50
.2284		5.80	.3160			.4134		10.50	.7812	25/32	
.2323		5.90	.3189		8.10	.4219	27/64		.7874		20.00
.2340			.3228		8.20	.4331		11.00	.7969	51/64	
.2344	15/64		.3230			.4375	7/16		.8071		20.50
.2362		6.00	.3248		8.25	.4528		11.50	.8125	13/16	
.2380			.3268		8.30	.4531	29/64		.8268		21.00
.2402		6.25	.3281	21/64		.4688	15/32		.8281	53/64	
.2480		6.30	.3307		8.40	.4724		12.00	.8438	27/32	
.2500	1/4		.3320			.4844	31/64		.8465		21.50
.2520		6.40	.3347		8.50	.4921		12.50	.8594	55/64	
.2559		6.50	.3386		8.60	.5000	1/2		.8661		22.00
.2570			.3390			.5118		13.00	.8750	7/8	
.2598		6.60	.3425		8.70	.5156	33/64		.8858		22.50
.2610			.3438	11/32		.5312	17/32		.8906	57/64	
.2638		6.70	.3445		8.75	.5315		13.50	.9055		23.00
.2656	17/64		.3465		8.80	.5469	35/64		.9062	29/32	
.2658		6.75	.3480			.5512		14.00	.9219	59/64	
.2660			.3504		8.90	.5625	9/16		.9252		23.50
.2677		6.80	.3543		9.00	.5709		14.50	.9375	15/16	
.2717		6.90	.3580			.5781	37/64		.9449		24.00
.2720			.3583		9.10	.5906		15.00	.9531	61/64	
.2756		7.00	.3594	23/64		.5938	19/32		.9646		24.50
.2770			.3622		9.20	.6094	39/64		.9688	31/32	
.2795		7.10	.3642		9.25	.6102		15.50	.9843		25.00
.2810			.3661		9.30	.6250	5/8		.9844	63/64	
.2812	9/32		.3680			.6299		16.00	1.0000	1	
.2835		7.20	.3701		9.40	.6406	41/64				

M #3

FRACTION/DECIMAL CONVERSION

DIRECTIONS: Using the Conversion Chart, answer the following questions.

1. What is the decimal equivalent of 7/16? ____________________

2. What is the fraction equivalent of .3906? ____________________

3. What is the decimal equivalent of 1? ____________________

4. What is the fraction equivalent of .7500? ____________________

5. What is the decimal equivalent of 3/8? ____________________

6. What is the fraction equivalent of .2188? ____________________

7. What is the decimal equivalent of 11/32? ____________________

8. What is the fraction equivalent of .2500? ____________________

9. What is the decimal equivalent of 15/16? ____________________

10. What is the fraction equivalent of .4844? ____________________

MACHINIST

Physical Demands/Working Environment

Lift 50 lbs. maximum with frequent lifting and/or carrying of objects weighing up to 25 lbs. (Medium work)
Bend body downward and forward by bending the spine at the waist (stooping)
Bend legs at the knees to come to rest on the knee or knees (kneeling)
Bend body downward and forward by bending the legs and spine (crouching)
Move about on the hands and knees or hands and feet (crawling)
Extend the hands and arms in any direction (reaching)
Seize, hold, grasp, turn or otherwise work with the hand or hands (handling)
Pick, pinch, or otherwise work with the fingers (fingering)
Perceive size, shape, temperature or texture of objects and materials by using fingertips (feeling)
Ability to work inside
Ability to work in extreme noise, constant or intermittent, causing marked distraction or possibly injury to hearing
Ability to work in extreme vibration, i.e., strain on body or extremities from repeated motion or shock

In most cases, the assessment of these skills will indicate that the student has the gross and fine motor skills which are prerequisites to learning the vocational skills in a Machinist program. Prior to instruction in any physical demands activities, the student should have been evaluated and parents contacted to make sure that the student has no hidden physical problems that could be aggravated by lifting objects or by other physical activities done in this area. However, if the student has a physical disability or other limitation(s) preventing him/her from demonstrating fine and gross motor skills, then other techniques may be taught so he/she can perform in the vocational program. Other persons to use as resources in this area include: physical education teacher, industrial arts teacher, special education teacher, and parents.

1. Student will identify objects in the school that weigh 25-50 pounds. Check student list for accuracy.

2. Review the Instructional Module entitled Physical Demand Movements. Observe student lifting an object of 25 pounds, carrying it 10-15 feet and putting it down. Correct any improper techniques used.

3. Obtain information from physical education teacher or industrial arts teacher on student's range of motion (bending, stooping, kneeling, crouching).

4. Obtain an assortment of wood and metal screws. Student will sort them according to size, shape, and use.

5. Time how long it takes student to sort 50 screws by size and shape and repeat the task, asking student to perform as quickly as possible. (Student should be able to finish the task much more quickly than in #4).

6. Obtain information from student, parent or other teachers concerning student's eye-hand-foot coordination. Some examples might include driving a manual transmission automobile/truck/tractor or running a sewing machine.

7. Visit the machinist class/lab in the area vocational school. Student should observe the environment and write or orally describe it upon return to school.

SUGGESTIONS FOR PARENTS:

1. Have student identify objects in the home that weigh between 25 and 50 pounds.

2. Visit a machine shop in the community so student has an understanding of the environment.

MACHINIST

Aptitudes- indicates an ability to:

coordinate eyes and hands or fingers rapidly and accurately (K-motor coordination)
make a movement response accurately and swiftly (K-motor coordination)

1. Allow student as much time as possible to practice eye-hand coordination on activities such as a typewriter or computer keyboard.
2. If access to a computer and software is available, allow student to practice some timed programs, such as drill/practice or even video games which require quick reaction times.
3. Using a collection of old nails, screws, etc., student will sort usable ones from broken (unusable) ones as quickly as possible.
4. Using small paper bags or baggies, student will package the usable screws/nails (designate number per package based on number available) and staple or paper clip the bags.

SUGGESTIONS FOR PARENTS:

1. Demonstrate how to sharpen a knife and allow student to practice for experience in safety and working with sharp metals.
2. Using a hand or power drill, allow student to drill holes in wood, or preferably metal scrap pieces.
3. Allow student to practice using C-clamps to hold objects securely.

MACHINIST

Temperament- indicates an ability to adapt to:

making generalizations, evaluations, or decisions based on sensory or judgmental criteria
situations requiring the precise attainment of set limits, tolerances, or standards

1. Given Worksheet M #4, student will answer the questions, using the charts provided.

   Answers to Worksheet M #4:

   1. 1550/1650
   2. 110,000 psi
   3. 235
   4. 200-250 sfpm
   5. 1045
   6. Aluminum
   7. 843/871
   8. 58%
   9. .005-.015 in.
   10. 40-55
   11. 1500/1550
   12. .300-.700 inches
   13. Stainless steel
   14. 187
   15. .015-.030 inches

2. Using a borrowed textbook or machine tool catalog, student will locate pictures of the tools listed on the tool list.

3. Given a piece of graph paper, student will draw a football field to the scale 1/4 inch = 1 yard.

4. Given Worksheet M #5, unlined paper (typing paper) and a ruler with 1/32 in. gradations, student will draw an exact replica of the picture on Worksheet M #5.

SUGGESTIONS FOR PARENTS:

1. Encourage student to discuss current events or happenings at home or school. Help student draw generalizations and make evaluations of the situations.

2. Require high quality work on all assigned tasks.

CHART 1

Machinability, Hardness, and Tensile Strength of Common Steels and Other Metals and Alloys

SAE Number	AISI Number	Tensile Strength (psi)	Hardness (Brinell)	Machinability Rating (percent)
CARBON STEELS				
1015	C1015	65,000	137	50
1020	C1020	67,000	137	52
X 1020	C1022	69,000	143	62
1025	C1025	70,000	130	58
1030	C1030	75,000	138	60
1035	C1035	88,000	175	60
1040	C1040	93,000	190	60
1045	C1045	99,000	200	55
1095	C1095	100,000	201	45
FREE-CUTTING STEELS				
X 1113	B1113	83,000	193	120-140
1112	B1112	67,000	140	100
....	C1120	69,000	117	80
MAGANESE STEELS				
X 1314	. . .	71,000	135	94
X 1335	A1335	95,000	185	70
NICKEL STEELS				
2315	A2317	85,000	163	50
2330	A2330	98,000	207	45
2340	A2340	110,000	225	40
2345	A2345	108,000	235	50
NICKEL-CHROMIUM STEELS				
3120	A3120	75,000	151	50
3130	A3130	100,000	212	45
3140	A3140	96,000	195	57
3150	A3150	104,000	229	50
3250	. . .	107,000	217	44
MOLYBDENUM STEELS				
4119	. . .	91,000	179	60
X 4130	A4130	89,000	179	58
4140	A4140	90,000	187	56
MOLYBDENUM STEELS (continued)				
4150	A4150	105,000	220	54
X 4340	A4340	115,000	235	58
4615	A4615	82,000	167	58
4640	A4640	100,000	201	69
4815	A4815	105,000	212	55
CHROMIUM STEELS				
5120	A5120	73,000	143	50
5140	A5140		174-229	60
52100	E52101	109,000	235	45
CHROMIUM-VANADIUM STEELS				
6120	A6120		179-217	50
6150	A6150	103,000	217	50
OTHER ALLOYS AND METALS				
Aluminum (11S)		49,000	95	300-2,000
Brass, Leaded		55,000	RF 100	150-600
Brass, Red/Yellow		25-35,000	40-55	200
Bronze, Lead-Bearing		22-32,000	30-65	200-500
Cast Iron, Hard		45,000	220-240	50
Cast Iron, Medium		40,000	193-220	65
Cast Iron, Soft		30,000	160-193	80
Cast Steel (0.35 C)		86,000	170-212	70
Copper (F.M.)		35,000	RF 85	65
Low-Alloy, High-Strength Steel		98,000	187	80
Magnesium Alloys				500-2,000
Malleable Iron				
Standard		53-60,000	110-145	120
Pearlitic		80,000	180-200	90
Pearlitic		97,000	227	80
Stainless Steel (12% Cr F.M.)		120,000	207	70

CHART READING

CHART 2

Recommended Heat Treatment Temperatures for Selected Frames and Kinds of Steel

AISI or SAE Number	Hardening Temperature Range		Annealing Temperature Range		Normalizing Temperature Range		Quenching Medium
	°F	°C	°F	°C	°F	°C	
1030	1550/1600	843/871	1525/1575	829/857	1625/1725	885/941	
1040	1500/1550	816/843	1475/1525	802/829	1600/1700	871/927	
1050	1475/1525	802/829	1450/1500	788/816	1550/1650	843/899	
1060	1450/1500	788/816	1425/1475	774/802	1500/1600	816/871	
1070	1450/1500	788/816	1425/1475	744/802	1500/1600	816/871	Water or brine
1080	1400/1450	760/788	1375/1425	746/774	1475/1575	802/857	
1090	1400/1450	750/788	1375/1425	746/774	1475/1575	802/857	
1132	1550/1600	843/871	1525/1575	829/857	1625/1725	885/941	
1140	1500/1550	816/843	1475/1525	802/829	1600/1700	871-927	
1151	1475/1525	802/829	1450/1500	788/816	1550/1650	843/899	
1330	1525/1575	829/857	1500/1550	816/843	1600/1700	871/927	Oil or water
1340	1500/1550	816/843	1475/1525	802/829	1550/1650	843/899	Oil or water
3140	1475/1525	802/829	1475/1525	802/829	1550/1650	843/899	Oil
4028	1550/1600	843/871	1525/1575	829/857	1600/1700	871/927	Oil or water
4042	1500/1550	816/843	1475/1525	802/829	1550/1650	843/899	Oil
4063	1475/1525	802/829	1450/1500	788/816	1550/1650	843/899	Oil
4130	1550/1600	843/871	1525/1575	829/857	1600/1700	871/927	Oil or water
4140	1525/1575	829/857	1500/1550	816/843	1600/1700	871/927	Oil
4150	1500/1550	816/843	1475/1525	802/829	1600/1700	871/927	Oil
4340	1500/1550	816/843	1500/1550	816/843	1600/1700	871/927	Oil

CHART 3

Recommended Cutting Speeds and Feeds for Various Depths of Cut on Common Metals (Single-Point Carbide Cutting Tools)

Metal	Depth of Cut (inches)	Feed per Revolution (inches)	Cutting Speed (sfpm)
Aluminum	.005-.015	.002-.005	700-1000
	.020-.090	.005-.015	450-700
	.100-.200	.015-.030	300-450
	.300-.700	.030-.090	100-200
Brass, Bronze	.005-.015	.002-.005	700-800
	.020-.090	.005-.015	600-700
	.100-.200	.015-.030	500-600
	.300-.700	.030-.090	200-400
Cast Iron (gray)	.005-.015	.002-.005	350-400
	.020-.090	.005-.015	250-350
	.100-.200	.015-.030	200-250
	.300-.700	.030-.090	75-150
Machine Steel	.005-.015	.002-.005	700-1000
	.020-.090	.005-.015	550-700
	.100-.200	.015-.030	400-500
	.300-.700	.030-.090	150-300
Tool Steel	.005-.015	.002-.005	500-700
	.020-.090	.005-.015	400-500
	.100-.200	.015-.030	300-400
	.300-.700	.030-.090	100-300
Stainless Steel	.005-.015	.002-.005	375-500
	.020-.090	.005-.015	300-375
	.100-.200	.015-.030	250-300
	.300-.700	.030-.090	75-175

M #4

CHART READING

DIRECTIONS: Study the three charts and answer the following questions using the correct chart.

1. What is the normalization temperature range (°F) for SAE number 1151?

   ____

2. What is the tensile strength of nickel steel, SAE number 2340?

   ______________________________ psi

3. What is the hardness of chromium steel AISI number E52101?

   ____

4. What is the cutting speed for a cast iron depth of cut .100-.200?

   ______________________________ sfpm.

5. What is the SAE number of carbon steel AISI number C1045?

   ____

6. The machinability rating for a certain metal is 300-2000%. What is the metal?

   ____

7. What is the hardening temperature range (°C) of AISI number 4028?

   ____

8. What is the machinability rating for molybdenum steel #4615?

   ______________________________ %

9. What is the feed per revolution on tool steel that is cut to a depth of .020-.090?

   ______________________________ inches

10. What is the hardness of red or yellow brass?

    ____

11. What is the annealing temperature range (°F) for SAE number 4140?

    ____

12. If the cutting speed for bronze metal is 200-400, what is the depth of cut?

    ______________________________ inches

13. The tensile strength of a certain metal is 120,000. What is the metal?

    ____

14. What is the hardness rating on low alloy, high strength steel?

    ____

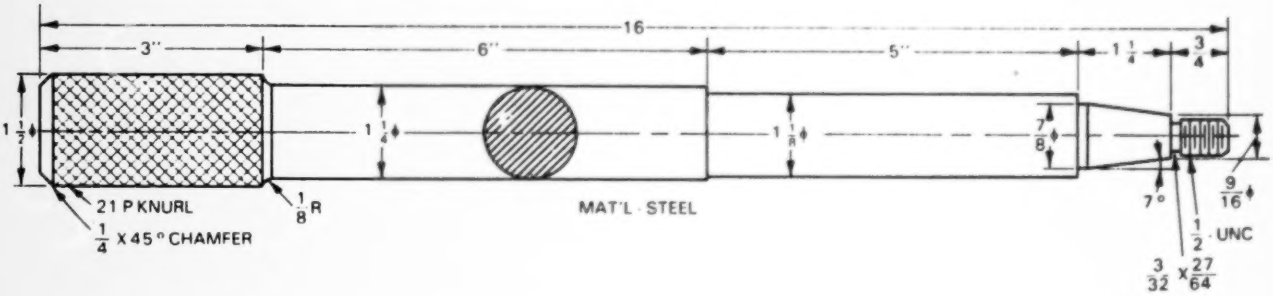
15. The depth of cut on machine steel is .100-.200. What is the correct feed per revolution?

    ______________________________ inches

M #5

Worksheet

ROUND SHAFT DRAWING


16
3"
6"
5"
1 1/4
3/4
1 1/2 ⌀
1 1/4 ⌀
1 1/8 ⌀
7/8 ⌀
9/16 ⌀
21 P KNURL
1/4 X 45° CHAMFER
1/8 R
MAT'L - STEEL
7°
1/2 - UNC
3/32 X 27/64

DIRECTIONS: Draw an exact replication of the above picture.

MACHINIST

Vocational

identify basic hand tools and equipment
use basic hand tools and equipment
demonstrate knowledge of basic safety concepts

1. Using a general tool catalog, student will identify common hand and power tools.

2. Obtain information from industrial arts teacher or parent on student's ability to use common hand and power tools.

3. Student will find a broken object (chair, "stuck" desk drawer, broken pencil sharpener, etc.) either at home or school. Student will find out the procedures for fixing it by looking in books, talking with teachers, friends, etc. He/she will write out the steps for repair and the tools used to make the repair.

4. Given Worksheet M #6, student will study it and state orally, or in writing, 8 out of 15 safety rules for the machine shop.

5. Given Worksheet M #7, student will answer questions regarding drilling problems.

   Answers for Worksheet M #7:

   1. a. excessive feed
      b. insufficient lip clearance
   2. Adjust/correct amount of free movement in spindle
   3. Spring in the workpiece
   4. Rapid wearing of cutting edge corners
   5. Excessive feed or rate of feed too high

SUGGESTIONS FOR PARENTS:

1. Visit a machine shop and discuss the safety precautions observed.

2. Discuss home safety rules.

3. Have student inspect the home for any safety problems.

Worksheet

Safety in the Machine Shop

Directions: Study these safety rules and be prepared to state at least 8 of them.

1. WEAR COMFORTABLE CLOTHES, BUT NOT TOO BAGGY.
2. NECKTIES, BELTS WITH LONG ENDS, OR JEWELRY SHOULD NOT BE WORN WHEN WORKING WITH MACHINES.
3. SHOES SHOULD BE LEATHER AND IF POSSIBLE, HAVE STUD TOES.
4. WEAR A HARD HAT AT ANY WORKSITE.
5. GOGGLES SHOULD BE WORN AT ALL TIMES IN THE SHOP.
6. DO NOT CARRY CIGARETTE LIGHTERS FILLED WITH BUTANE OR PROPANE.
7. WEAR WELDING GLOVES ONLY WHEN WELDING.
8. USE PROPER LIFTING TECHNIQUES.
9. NEVER USE COMPRESSED AIR TO CLEAN MACHINES OR CLOTHING.
10. KEEP TOOLS AND MATERIALS OFF THE MACHINE TABLES.
11. SWEEP UP THE METAL CHIPS AROUND THE MACHINES AS OFTEN AS POSSIBLE.
12. ALWAYS STOP (OR UNPLUG) A MACHINE BEFORE CLEANING IT.
13. ALWAYS REMOVE BURRS OR SHARP EDGES FROM WORKPIECES.
14. USE GLOVES OR A RAG WHEN HANDLING SHARP TOOLS OR WORKPIECES.
15. BE SURE ALL SAFETY GUARDS ARE IN PLACE BEFORE USING A MACHINE.

Worksheet

DRILLING PROBLEMS

Drilling Problems: Causes and Corrective Action

Problem	Possible Cause	Corrective Action
Drill breaking	-Dull drill point	-Regrind drill point
	-Insufficient lip clearance	-Check angle of lip clearance
	-Spring in the workpiece	-Reclamp workpiece securely
	-Feed too great in relation to cutting speed	-Decrease feed or step up the cutting speed
Drill breaking (nonferrous and other soft materials)	-Flutes clogged with chips	-Use appropriate drill for the material
	-Cutting point digging into the material	-Remove the drill a number of times so the chips clear the hole -Increase the cutting speed -Grind a zero rake angle
Rapid wearing of cutting edge corners	-Cutting speed too fast	-Reduce cutting speed
	-Work hardness; hard spots, casting scale, or sand particles	-Sand blast or tumble castings, or heat treat -Change method of flowing the coolant and check for correct cutting fluid
Margin chipping (using drill jig)	-Jig bushing too large	-Replace drill bushing with same size as drill
Cutting edge and lip chipping	-Lip clearance too great	-Regrind to proper lip clearance
	-Rate of feed too high	-Reduce the feed rate
Cracking or chipping of high-speed steel drill	-Excessive feed	-Reduce the feed rate
	-Improper quenching during grinding or drilling	-Quench gradually with warmer coolant when grinding
Change in cutting action	-Drill dulling; cutting edge damaged	-Regrind the drill point correctly
	-Variations in the hardness of the workpiece	-Anneal the workpiece
	-Change in the amount of cutting fluid reaching the drill point	-Increase the direction or rate of flow of the cutting fluid
Oversize drilled hole	-Improper grinding of point with equal angles and length of cutting edges	-Check reground cutting angle and length of cutting edges
	-Excessive play in spindle	-Adjust or correct amount of free movement in spindle
	-Slightly bent drill	-Straighten drill carefully
Cutting on one lip	-Angle of cutting lips varies -Unequal length of cutting lips	-Regrind and check accuracy of cutting edges and length of cutting edges
Poor quality of surface finish	-Improperly ground drill point	-Regrind and check accuracy of drill point
	-Excessive drill feed	-Decrease drill feed
	-Wrong cutting fluid or limited rate of flow	-Change cutting fluid for the kind of material
	-Workpiece not correctly secured	-Reposition and secure the workpiece securely
Drill splitting (along the center)	-Excessive feed	-Decrease drill feed
	-Insufficient lip clearance	-Increase the lip clearance to the correct angle

M #7

DRILLING PROBLEMS

DIRECTIONS: Using the Drilling Problems chart, answer the following questions.

1. If the problem is drill splitting along the center, what are the possible causes?

   (1) ____

   (2) ____

2. If the drill hole is oversized and the problem is too much play in the spindle, the solution is:

   ____

3. If the drill breaks and the solution was reclamping the workpiece, what was the problem?

   ____

4. If the cutting speed is too fast, what kinds of problems might be seen?

   ____

5. If the corrective action is to decrease the drill feed, what is the possible cause?

   ____

RESOURCES

MACHINIST

Curriculum Publications Clearinghouse
Western Illinois University
Horrabin Hall 46
Macomb, IL 61455

Machine Shop Fundamentals

Delmar Publishers
2 Computer Drive West
Box 15-015
Albany, NY 12205

Mathematics for Sheet Metal Fabrication
Practical Problems in Mathematics for Machinists, Hoffman, E. G.

Instructional Materials Laboratory
908 Woodson Way
University of Missouri-Columbia
Columbia, MO 65211

Micrometers, Calipers, and Gages
Explanation on use of measuring devices such as micrometers, vernier calipers, thickness gages, and wire gages.

Vocational Machine Shop
Technical information and skill development activities. Lesson plans are suitable for secondary and postsecondary programs.
Vocational Machine Shop is available in the following sections:

- Vocational Machine Shop - Section A
  - Unit I: Introduction to Machine Shop
  - Unit II: Blueprint Reading
  - Unit III: Machine Shop Math
- Vocational Machine Shop - Section B
  - Unit IV: Measurement
  - Unit V: Layout Work
  - Unit VI: Bench Work
- Vocational Machine Shop - Section C
  - Unit VII: Power Sawing
  - Unit VIII: Drill Press Work
- Vocational Machine Shop - Section D
  - Unit IX: Lathe Work
- Vocational Machine Shop - Section E
  - Unit X: Shaper Work
- Vocational Machine Shop - Section F
  - Unit XI: Vertical Milling
  - Unit XII: Horizontal Milling

Vocational Machine Shop - Section G
Unit XIII: Surface Grinding
Unit XIV: Cylindrical Grinding
Unit XV: Cutting Grinding
Vocational Machine Shop - Section H
Unit XVI: Heat Treatment and Metallurgy

Motivation Development, Inc.
P.O. Box 427
Bishop, CA 93514

Machine Mathematics, Wiltsie, D.
Practical Uses for Formulas and Equations, Wiltsie, D.

Occupational Curriculum Laboratory
East Texas State University
Commerce, TX 75428

Individualized Study Guides for General Metal Trades"
Drill Press Operator
Lathe Operator
Milling Machine Operator

General Metal Trades, Book I

SMALL ENGINE REPAIR AND AGRICULTURAL POWER I/AGRICULTURAL MACHINERY

Sample Occupational Areas:
Engine Repairer, Production
Gas Engine Repairer
Power Saw Mechanics
Small Engine Mechanic

Introduction

This vocational class is sometimes called Agricultural Power I/Small Engine Repair or Agricultural Machinery. All classes deal with the small, gasoline powered engine, such as is found in lawnmowers, chain saws and other small power equipment. Sometimes this class is a prerequisite for other classes (Auto Mechanics, Diesel Mechanics, Agricultural Power II - tractors and heavy farm equipment). The small engine repair class gives students basic knowledge about engines, and it should be suggested that students who want to enter the mechanics area enroll in this kind of class.

Students entering the small engine repair class need good mechanical, spatial relations, and dexterity skills. They will be working with hand and power tools, disassembling and reassembling small engine parts, and referring to service manuals for instructions and parts numbers.

VIMS COMPETENCIES FOR AGRICULTURAL POWER I

The student has mastered the related competencies of Agricultural Science I and II.

A. Explaining Principles of Operation

1. Explain the operating principles of a two-cycle engine
2. Explain the operating principles of a four-cycle engine
3. Identify safety procedures to follow when servicing and repairing a single cylinder engine *

Other (specify):

B. Using Measuring Tools

1. Demonstrate the use of a micrometer
2. Demonstrate the use of a dial caliper
3. Demonstrate the use of a telescoping gauge
4. Demonstrate the use of a dial indicator
5. Demonstrate the use of a torque wrench
6. Demonstrate the use of a reject gauge (GO-NO GO gauge)
7. Demonstrate the use of a feeler gauge

Other (specify):

C. Using Shop Tools and Equipment

1. Demonstrate the use of shop hand tools
2. Demonstrate the use of shop power tools
3. Demonstrate the use of cleaning equipment

Other (specify):

D. Selecting Engine Parts and Fasteners

1. Identify parts of an engine
2. Select, install or assemble parts
3. Select correct engine fasteners

Other (specify):

E. Using a Service Manual

1. Interpret and apply a service manual
2. Select oils, fuels and lubricants

Other (specify):

F. Testing and Analyzing a Single Cylinder Engine System

1. Test and analyze a carburetion system
2. Test and analyze a compression system
3. Test and analyze an ignition system
4. Test and analyze a fuel injection system
5. Test and analyze an electrical system
6. Test and analyze a lubrication system
7. Test and analyze a governor system

Other (specify):

G. Servicing a Single Cylinder Engine

1. Clean, adjust and/or repair a carburetor
2. Service and adjust an electrical system
3. Grind and adjust valves
4. Recondition or replace cylinders and pistons
5. Service and repair a lubrication system
6. Clean and service a cooling system
7. Clean and service an air intake and exhaust system
8. Service and repair a mechanical starting system
9. Prepare engine for winter storage

Other (specify):

---

* All competencies involving safety require a Number 3 Rating - Mastered.

SMALL ENGINE REPAIR AND
AGRICULTURAL POWER I/AGRICULTURAL MACHINERY
ACCESS SKILLS CHECKLIST

Student Name/ID ______________________ Sending School ______________________

Instructor ______________________ Date(s) Evaluated ______________________

Circle proper mastery code: 3 = MASTERY 2 = REQUIRES SUPERVISION
1 = NOT MASTERED N or blank = NO EXPOSURE

TASK DESCRIPTION	TASK ID #	MASTERY CODE	MASTERY DATE	RETRY CODE/DATE
1. Count two-place numbers	470696A001	3 2 1 N		
2. Add two-place numbers	470696A002	3 2 1 N		
3. Subtract two-place numbers	470696A003	3 2 1 N		
4. Perform standard units of measurement, i.e., cup, pint, quart, inch, foot, yard, ounce, pound	470696A004	3 2 1 N		
5. Use basic measuring instruments, i.e., rulers, scales	470696A005	3 2 1 N		
6. Multiply two-place numbers	470696A006	3 2 1 N		
7. Divide two-place numbers	470696A007	3 2 1 N		
8. Add common fractions	470696A008	3 2 1 N		
9. Subtract common fractions	470696A009	3 2 1 N		
10. Multiply common fractions	470696A010	3 2 1 N		
11. Divide common fractions	470696A011	3 2 1 N		
12. Add two-place decimals	470696A012	3 2 1 N		
13. Subtract two-place decimals	470696A013	3 2 1 N		
14. Multiply two-place decimals	470696A014	3 2 1 N		
15. Divide two-place decimals	470696A015	3 2 1 N		
16. Lift 50 lbs. maximum with frequent lifting and/or carrying of objects weighing up to 25 lbs. (Medium work)	470696B001	3 2 1 N		
17. Extend the hands and arms in any direction (reaching)	470696B002	3 2 1 N		
18. Seize, hold, grasp, turn or otherwise work with the hand or hands (handling)	470696B003	3 2 1 N		
19. Pick, pinch, or otherwise work with the fingers (fingering)	470696B004	3 2 1 N		
20. Perceive size, shape, temperature or texture of objects and materials by using fingertips (feeling)	470696B005	3 2 1 N		
21. Ability to work inside	470696B006	3 2 1 N		
22. Ability to work in extreme noise, constant or intermittent, causing marked distraction or possibly injury to hearing	470696B007	3 2 1 N		
23. Ability to work in extreme vibration, i.e., strain on body or extremities from repeated motion or shock	470696B008	3 2 1 N		

SMALL ENGINE REPAIR AND AGRICULTURAL POWER I/AGRICULTURAL MACHINERY ACCESS SKILLS CHECKLIST

Student Name/ID ______________________ Sending School ______________________

Instructor ______________________ Date(s) Evaluated ______________________

Circle proper mastery code: 3 = MASTERY 2 = REQUIRES SUPERVISION
1 = NOT MASTERED N or blank = NO EXPOSURE

TASK DESCRIPTION	TASK ID #	MASTERY CODE	MASTERY DATE	RETRY CODE/DATE
24. Think visually of geometric forms (S-spatial)	470696C001	3 2 1 N		
25. Comprehend the two dimensional representation of three-dimensional objects (S-spatial)	470696C002	3 2 1 N		
26. Recognize the relationship resulting from the movements of objects in space (S-spatial)	470696C003	3 2 1 N		
27. Perceive pertinent detail in objects in pictorial or graphic material (P-form perception)	470696C004	3 2 1 N		
28. Make visual comparisons and discriminations and see slight differences (P-form perception)	470696C005	3 2 1 N		
29. Coordinate eyes and hands or fingers rapidly and accurately (K-motor coordination)	470696C006	3 2 1 N		
30. Make a movement response accurately and swiftly (K-motor coordination)	470696C007	3 2 1 N		
31. Move the fingers and manipulate small objects with the fingers, rapidly or accurately (F-finger dexterity)	470696C008	3 2 1 N		
32. Making generalizations, evaluations, or decisions based on measurable or verifiable criteria	470696D001	3 2 1 N		
33. Situations requiring the precise attainment of set limits, tolerances, or standards	470696D002	3 2 1 N		
34. Identify basic hand tools and equipment	470696E001	3 2 1 N		
35. Use basic hand tools and equipment	470696E002	3 2 1 N		
36. Demonstrate knowledge of basic safety concepts	470696E003	3 2 1 N		

SMALL ENGINE REPAIR AND
AGRICULTURAL POWER I/AGRICULTURAL MACHINERY
VOCABULARY LIST

AIR CLEANER	filter that cleans the air before it enters the carburetor
BREATHER	device used to maintain a vacuum in a crankcase
CARBURETOR	mixes air and fuel in the correct amount to burn in the engine
CRANKCASE	part of the engine that supports the crankshaft
CRANKSHAFT	an offset shaft to which the piston and connecting rod are attached
CYLINDER BLOCK	the largest part of the engine which contains the cylinder
CYLINDER HEAD	the top of the cylinder block which contains the spark plug and cylinder
FUEL TANK	container for gasoline
KILL SWITCH	metal part used to stop the engine
MUFFLER	used to reduce engine noise
OIL FILTER PLUG	plug that covers the hole where the oil is added to the crankcase
OPERATOR'S MANUAL	used to look up detailed information about a specific small engine
SPARK PLUG	produces a spark to ignite the air and fuel from the carburetor

TOOL LIST FOR SMALL ENGINE REPAIR AND AGRICULTURAL POWER I/AGRICULTURAL MACHINERY

Adjustable wrench

Allen wrench

Box-end wrench

Ball peen hammer

Cutting pliers

Flat blade screwdriver

Flat feeler gauge

Flywheel holder

Flywheel puller

Longnose pliers

Offset screwdriver

Open-end wrench

Phillips screwdriver

Piston stop

Sockets (standard and deep)

Socket wrench

Soft face hammer

Starter clutch wrench

Torque wrench

Wire feeler gauge

SMALL ENGINE REPAIR AND
AGRICULTURAL POWER I/AGRICULTURAL MACHINERY

Math Skills

Count two-place numbers
Add two-place numbers
Subtract two-place numbers
Perform standard units of measurement, i.e., cup, pint, quart, inch, foot, yard, ounce, pound
Use basic measuring instruments, i.e., rulers, scales
Multiply two-place numbers
Divide two-place numbers
Add common fractions
Subtract common fractions
Multiply common fractions
Divide common fractions
Add two-place decimals
Subtract two-place decimals
Multiply two-place decimals
Divide two-place decimals

NOTE: Many math books and workbooks provide needed direction in learning basic operations in math. This section assumes that students have basic skills and is designed to be used in conjunction with any of the math books you might be using, or to establish your own supplemental units. Any math practice activities should be developed within the context of the vocational program. Other persons to use as resources in this area include: parents, math teacher, and industrial arts teacher.

1. Given several different sizes of containers, student will fill the containers 1/4 full.

2. Given several different sizes of nuts and/or bolts, student will choose the correct size wrench to tighten/loosen the nut/bolt.

3. Given a flat or wire feeler gauge, the student will correctly measure items given to him/her and state this measurement either in writing or verbally. (Items which students measure should have small gaps in them, such as an old spark plug, gaps in window casings or doors, gaps in desk drawers, etc.).

4. Student will be able to distinguish between the terms "clockwise" and "counterclockwise" and demonstrate the knowledge of turning a screw correctly upon request.

5. Student will be able to convert fractions to decimals and decimals to fractions.

6. Given the formula to figure piston displacement, student will be able to substitute numbers into the formula and correctly solve 80% of the worksheet problems (SER #1) using a calculator.

   Answers to Worksheet SER #1:

   1. 14.1372 or 14.14
   2. 6.2832 or 6.28
   3. 9.82
   4. 9.50
   5. 10.62

SUGGESTIONS FOR PARENTS:

1. Encourage student to use different kinds of measurement tools accurately (tape measure, measuring cups and spoons).

2. Encourage student to use math in daily living. For example, figuring the discount on items advertised in the newspaper, figuring the cost of gasoline for a certain number of gallons, etc.

WORKSHEET

PISTON DISPLACEMENT

The formula for figuring piston displacement is:

$$\text{DISPLACEMENT} = \frac{(\text{BORE})^2}{4} \times \text{pi} \times \text{STROKE} \qquad [\text{pi} = 3.1416]$$

EXAMPLE:

What is the displacement of a piston which has a 2" bore and a 2" stroke?

$$\text{DISPLACEMENT} = \frac{(2)^2}{4} \times 3.1416 \times 2$$

$$= \frac{2 \times 2}{4} \times 3.1416 \times 2$$

$$= \frac{4}{4} \times 3.1416 \times 2$$

$$= 1 \times 3.1416 \times 2$$

$$= 6.2832$$

$$= 6.28 \text{ cubic inches}$$

PROBLEMS: Show your work.

1. What is the displacement of a piston which has a 3" bore and a 2" stroke?

2. What is the displacement of a piston which has a 2" bore and a 2" stroke?

3. What is the displacement of a piston which has a 2.5" bore and a 2" stroke?

4. What is the displacement of a piston which has a 2.2" bore and a 2.5" stroke?

5. What is the displacement of a piston which has a 2.6" bore and a 2" stroke?

SMALL ENGINE REPAIR AND AGRICULTURAL POWER I/AGRICULTURAL MACHINERY

Physical Demands/Working Environment

Lift 50 lbs. maximum with frequent lifting and/or carrying of objects weighing up to 25 lbs. (Medium work)
Extend the hands and arms in any direction (reaching)
Seize, hold, grasp, turn or otherwise work with the hand or hands (handling)
Pick, pinch, or otherwise work with the fingers (fingering)
Perceive size, shape, temperature or texture of objects and materials by using fingertips (feeling)
Ability to work inside
Ability to work in extreme noise, constant or intermittent, causing marked distraction or possibly injury to hearing
Ability to work in extreme vibration, i.e., strain on body or extremities from repeated motion or shock

In most cases, the assessment of these skills will indicate that the student has the gross and fine motor skills which are prerequisites to learning the vocational skills in a Small Engine Repair program. Prior to instruction in any physical demands activities, the student should have been evaluated and parents contacted to make sure that the student has no hidden physical problems that could be aggravated by lifting objects or by other physical activities done in this area. However, if the student has a physical disability or other limitation(s) preventing him/her from demonstrating fine and gross motor skills, then other techniques may be taught so he/she can perform in the vocational program. Other persons to use as resources in this area include: physical education teacher, industrial arts teacher, special education teacher, and parents.

1. Given objects weighing 10 lbs., 20 lbs., 30 lbs., 40 lbs., and 50 lbs., student will demonstrate ability to properly lift and carry the item at least 10 feet.

2. Given a set of tools and a tool box, student will sort the tools, assemble them into the toolbox and close the box. (Any number of items and boxes can be utilized for this activity. If tools are used, student can also identify the tools and check them off on an inventory sheet. The industrial arts teacher may have an inventory already developed which the student could complete).

3. Given small screws and washers, student will sort them according to size and shape, and put them into bags or containers.

4. If an assortment of nuts and bolts are available, student could assemble several nuts and bolts, with and without looking at the assembly. Many times nuts must be put onto bolts by touch only.

5. Visit an engine repair shop and discuss with student the noise level and vibration level of the shop and how well he or she could work all day long in that environment.

SUGGESTIONS FOR PARENTS:

1. Report the ability of student to work indoors in a shop area: i.e., the garage, the basement, etc.
2. Report how student reacts to loud noise or vibration.(Using vacuum cleaner, mowing the yard, using sewing machine, etc.).

SMALL ENGINE REPAIR AND
AGRICULTURAL POWER I/AGRICULTURAL MACHINERY

Aptitudes - indicates an ability to:

think visually of geometric forms (S-spatial)
comprehend the two dimensional representation of three-dimensional objects (S-spatial)
recognize the relationship resulting from the movements of objects in space (S-spatial)
perceive pertinent detail in objects in pictorial or graphic material (P-form perception)
make visual comparisons and discriminations and see slight differences (P-form perception)
coordinate eyes and hands or fingers rapidly and accurately (K-motor coordination)
make a movement response accurately and swiftly (K-motor coordination)
move the fingers and manipulate small objects with the fingers, rapidly or accurately (F-finger dexterity)

1. Student will correctly assemble a socket wrench.

2. Student will be able to correctly identify, by sight, the size of three different sockets or wrenches.

3. Given Worksheet SER #2 and instructions from the teacher, student will correctly answer 80% of the questions regarding the meaning of model numbers on engines.

   Answers to Worksheet SER #2:

   1. 32 cubic inch displacement
   2. plain bearing
   3. rope starter
   4. design series 6
   5. horizontal flo-jet (pneumatic governor)
   6. ball bearing
   7. alternator only
   8. 9 cubic inch displacement
   9. gear reduction (6 to 1)
   10. design series 8
   11. without starter

4. Given Worksheet SER #3, student will read the chart and answer the questions accurately.

   Answers to Worksheet SER #3:

   1. 19122
   2. .005,.007
   3. 65 ft lbs.
   4. 100 in.lbs.
   5. .012, .016
   6. 165 in. lbs.
   7. 1750
   8. 140000
   9. 220000, 250000
   10. all of them

5. Student will be able to identify major parts of a small engine after studying Worksheet SER #4.

SUGGESTIONS FOR PARENTS:

1. Report student's ability to handle tools such as a screwdriver, wrench and hammer.
2. Report student's ability to take apart and put things back together again (any item: toys, bicycles, etc.).

WORKSHEET

MODEL NUMBER SYSTEM

The chart below describes what each of the numbers in a model number mean. For example, the first 1 or 2 numbers show the cubic inch replacement. The next number shows the basic series design, and so forth. After studying the chart, answer the 11 questions. Your teacher will help you with the first question.

CUBIC INCH DISPLACEMENT	FIRST DIGIT AFTER DISPLACEMENT BASIC DESIGN SERIES	SECOND DIGIT AFTER DISPLACEMENT CRANKSHAFT, CARBURETOR GOVERNOR	THIRD DIGIT AFTER DISPLACEMENT BEARINGS, REDUCTION GEARS & AUXILIARY DRIVES	FOURTH DIGIT AFTER DISPLACEMENT TYPE OF STARTER
6	0	0 -	0 - Plain Bearing	0 - Without Starter
8	1	1 - Horizontal Vacu-Jet	1 - Flange Mounting Plain Bearing	1 - Rope Starter
9	2	2 - Horizontal Pulsa-Jet	2 - Ball Bearing	2 - Rewind Starter
10	3	3 - Horizontal Flo-Jet (Pneumatic Governor)	3 - Flange Mounting Ball Bearing	3 - Electric - 110 Volt, Gear Drive
11	4	4 - Horizontal Flo-Jet (Mechanical Governor)	4 -	4 - Elec. Starter-Generator - 12 Volt, Belt Drive
13	5	5 - Vertical Vacu-Jet	5 - Gear Reduction (6 to 1)	5 - Electric Starter Only - 12 Volt, Gear Drive
14	6	6 -	6 - Gear Reduction (6 to 1) Reverse Rotation	6 - Alternator Only *
17	7	7 - Vertical Flo-Jet	7 -	7 - Electric Starter, 12 Volt Gear Drive, with Alternator
19	8	8 -	8 - Auxiliary Drive Perpendicular to Crankshaft	8 - Vertical-pull Starter
20	9	9 - Vertical Pulsa-Jet	9 - Auxiliary Drive Parallel to Crankshaft	
23				
24				
25				
30				
32				

* Digit 6 formerly used for "Wind-Up" Starter on 60000, 80000 and 92000 Series

EXAMPLES

To identify Model 100202:

10	0	2	0	2
10 Cubic Inch	Design Series 0	Horizontal Shaft - Pulsa-Jet Carburetor	Plain Bearing	Rewind Starter

Similarly, a Model 92998 is described as follows:

9	2	9	9	8
9 Cubic Inch	Design Series 2	Vertical Shaft - Pulsa-Jet Carburetor	Auxiliary Drive Parallel to Crankshaft	Vertical Pull Starter

1. In the model 324522, the number 32 means:

____

2. In the model 148907, the 0 means:

____

3. In the model 103861, the 1 means:

____

4. In the model 86304, the 6 means:

____

5. In the model 203194, the 3 means:

____

6. In the model 176724, the 2 means:

____

7. In the model 244576, the 6 means:

____

8. In the model 98998, the first 9 means:

____

9. In the model 25767, the second 5 means:

____

10. In the model 68433, the 8 means:

____

11. In the model 300300, the last 0 means:

____

WORKSHEET

CHART READING

Find the answers to the questions below by reading the chart.

	BASIC MODEL SERIES	IDLE SPEED	ARMATURE		VALVE CLEARANCE		VALVE GUIDE REJECT GAGE	TORQUE SPECIFICATIONS		
			TWO LEG AIR GAP	THREE LEG AIR GAP	INTAKE	EXHAUST		FLYWHEEL NUT FT. LBS.	CYLINDER HEAD IN. LBS.	CONN. ROD IN. LBS.
ALUMINUM	6B, 60000	1750	.006 .010	.012 .016	.005 .007	.009 .011	19122	55	140	100
	8B, 80000, 81000, 82000	1750	.006 .010	.012 .016	.005 .007	.009 .011	19122	55	140	100
	92000, 94000	1750	.006 .010		.005 .007	.009 .011	19122	55	140	100
	100000	1750	.010 .014	.012 .016	.005 .007	.009 .011	19122	60	140	100
	110000	1750	.006 .010		.005 .007	.009 .011	19122	55	140	100
	130000	1750	.010 .014		.005 .007	.009 .011	19122	60	140	100
	140000	1750	.010 .014	.016 .019	.005 .007	.009 .011	19151	65	165	165
	170000, 171700•	1750 ••	.010 .014		.005 .007	.009 .011	19151	65	165	165
	190000, 191700•	1750 ••	.010 .014		.005 .007	.009 .011	19151	65	165	165
	220000, 250000	1750 ••	.010 .014		.005 .007	.009 .011	19151	65	165	190

1. The basic model series 110000 has a valve guide reject gauge of ______________.

2. The intake valve clearance in the model 920000, 940000 is between ______________ and ______________.

3. In the 220000 and 250000 series, the flywheel nut torque specification is ______________.

4. In the 130000 series, the connecting rod inch torque specification is ______________.

5. In the 6B series, the three leg air gap is between ________ and ________.

6. In the 171700 series, the cylinder head torque specification is ________.

7. In the 100000 series, the idle speed is ______________.

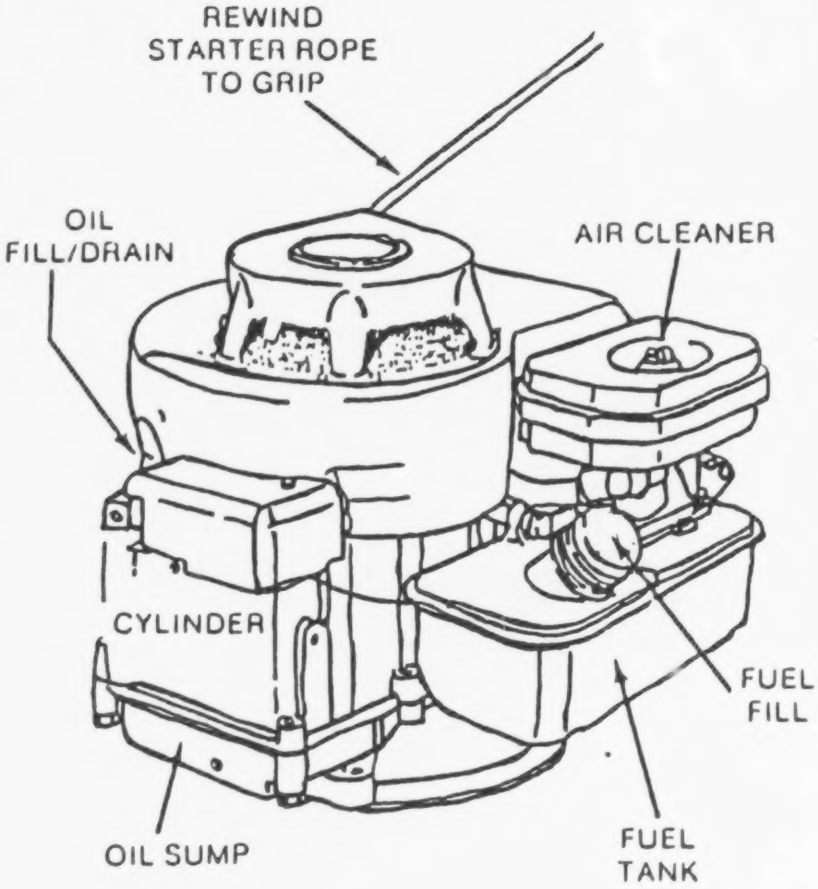
8. The three leg air gap of .016 to .019 is found in what model?
____

9. Which two model series have a connecting rod torque specification of 190 in. lbs.? ____________________ and ____________________.

10. Which model series have an exhaust valve clearance of .009 and .011?
____

WORKSHEET

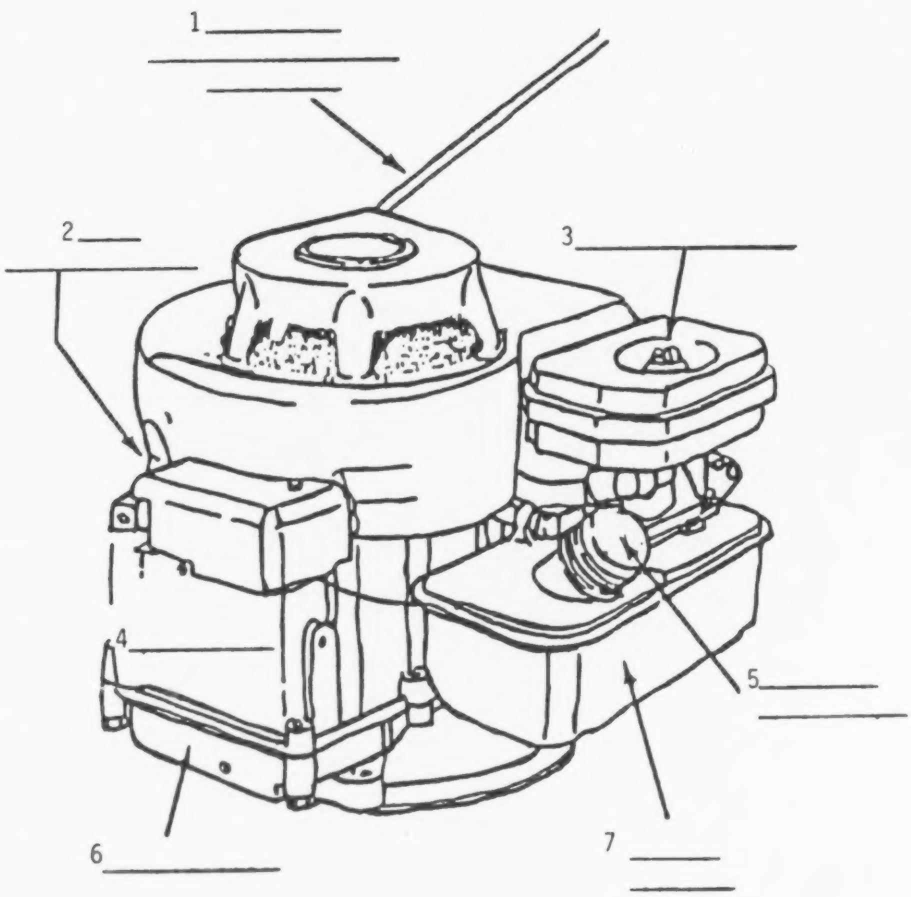
ENGINE PARTS - STUDY GUIDE


REWIND STARTER ROPE TO GRIP
OIL FILL/DRAIN
AIR CLEANER
CYLINDER
FUEL FILL
OIL SUMP
FUEL TANK

SER #4

WORKSHEET

ENGINE PARTS - IDENTIFICATION



SMALL ENGINE REPAIR AND
AGRICULTURAL POWER I/AGRICULTURAL MACHINERY

Temperament - indicates an ability to adapt to:

making generalizations, evaluations, or decisions based on measurable or verifiable criteria
situations requiring the precise attainment of set limits, tolerances, or standards

1. Student will list the reasons that he/she must be very accurate when repairing an engine.

   For example:
   (a) engine will not run
   (b) engine will break down again
   (c) other parts may be ruined if one part is not fixed correctly
   (d) a part could come off and hurt the operator
   (e) gasoline/oil may leak out and cause a fire

2. Given Worksheet SER #5 and SER #6, student will be able to identify the safety problems depicted in the pictures after studying the safety worksheet, with 100% accuracy.

SUGGESTIONS FOR PARENTS:

1. Give student the opportunity to make decisions based on criteria; for example, have student determine if lawn is free of sticks and debris before mowing.

2. Demand high quality work from student on all assigned chores.

SER #5

WORKSHEET

SAFETY RULES

1. DO NOT allow children in yard when mower is operating.

2. DO NOT allow children to operate mower.

3. Keep the area clear of all persons, particularly small children, and pets.

4. Thoroughly inspect the area where the mower is to be used and remove all stones, sticks, wire, bones and other foreign objects. Also note the location of holes, stumps, and other possible hazards.

5. Do not operate mower when barefoot or wearing open sandals. Always wear substantial footwear and long pants.

6. Never attempt to make a wheel height adjustment while the engine is running.

7. When mowing over rough ground or in tall grass, mower must be set in highest cutting position.

8. Mow only in daylight or in good artificial light.

9. Never operate mower in wet grass. Always be sure of your footing; keep a firm hold on the handle and walk; never run.

10. Do not put hands or feet near or under rotating parts. Keep clear of discharge area while engine is running.

11. Stop engine when crossing gravel drives, walks, or roads, and under any conditions where thrown objects might be a hazard.

12. Stop engine whenever you leave the operating position behind the handle for any reason, including emptying grass bag and making any adjustments, repairs, or inspections.

13. Before cleaning, repairing or inspecting, make certain blade and all moving parts have stopped. Disconnect and secure spark plug wire away from plug to prevent accidental starting.

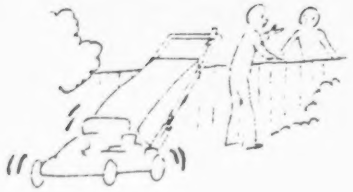
14. Keep all nuts, bolts, and screws tight to be sure mower is in safe operating condition.

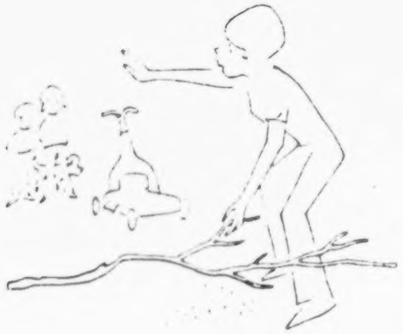
15. To reduce fire hazard, keep mower free of grass, leaves or excessive grease.

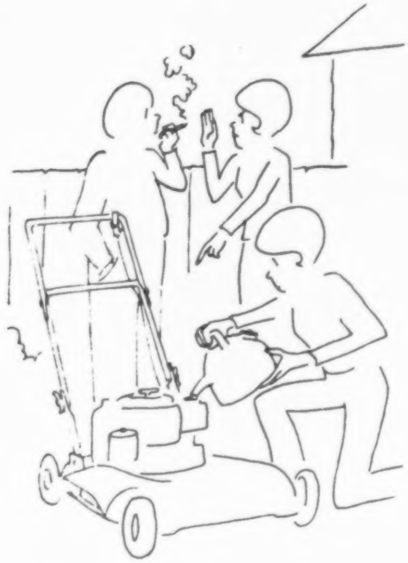
16. Do not leave mower running unattended.

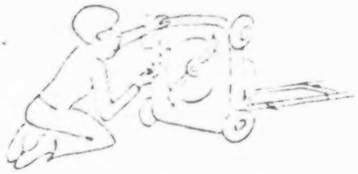
WORKSHEET

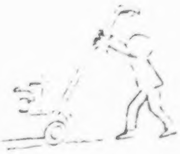
IDENTIFICATION OF SAFETY PROBLEMS

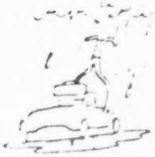


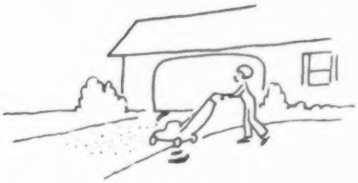


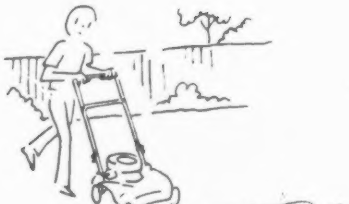












Circle the pictures which show a safety problem.

SMALL ENGINE REPAIR AND
AGRICULTURAL POWER I/AGRICULTURAL MACHINERY

Vocational

Identify basic hand tools and equipment
Use basic hand tools and equipment
Demonstrate knowledge of basic safety concepts

1. Student will be able to list five safety factors to observe in a shop area, such as wearing safety glasses, correct clothing and shoes, keeping clothing away from moving parts, cleaning up gasoline spills and oil spills, turning an engine off while checking gas and oil, never starting an engine in a closed area, disconnecting the spark plug when working on the engine and using the proper tools.

2. Student will visit a small engine repair shop (or vocational class) and note the safety factors she/he observes there.

3. Student will discuss how and when to use a fire extinguisher. A guest speaker may be helpful to introduce students to the use of fire extinguishers.

4. Student will discuss the reasons for cleaning up an area after working in relation to safety factors.

SUGGESTIONS FOR PARENTS:

1. Encourage the student to clean up tools and work area after use.

2. Observe the student filling a gasoline can and adding gas to a lawn mower. Discuss any poor safety practices.

3. Read and discuss various parts of an Owner's Manual for a lawnmower, chain saw, etc., with the student in relation to safety factors.

RESOURCES

SMALL ENGINE REPAIR AND AGRICULTURAL POWER I/AGRICULTURAL MACHINERY

Briggs & Stratton Corp.
12301 W. Wirth Street
Wauwatosa, WI 53222

Service and Repair Instructions

Instructional Materials Lab
908 Woodson Way
University of Missouri-Columbia
Columbia, MO 65211

Maintaining Small Engines: Vocational Preparation Curriculum, Herd, A.

WELDING

Sample Occupational Areas:
Gas Welding Equipment Mechanic
Welder Helper
Weld Inspector I
Welding Machine Helper, Arc
Welding Machine Operator, Gas
Welding Technician

Introduction

Welding is a very important and exciting activity. As a career, welding opportunities exist worldwide. Knowledgeable and experienced welders are hired in airplane construction, pipeline installation, shipbuilding, building construction, bridge construction and steel construction.

Before obtaining a job in any of these areas, a student must successfully complete welding training. Important abilities for students to possess before entering a welding program include demonstrating: safe work habits, basic math skills, the ability to select and use a number of large and small tools, the ability to check work for accuracy, great physical strength and endurance, as well as good eye-hand coordination. Welding can be a repetitive task, and sometimes dirty. Persons wishing to become employed in this area may have difficulty if allergies are a health problem for them.

VIMS COMPETENCIES FOR WELDING

A. Basic Skills

1. Identify and correct or report safety hazards
2. Identify and utilize proper storage for flammables
3. Identify and demonstrate correct use of fire extinguishers
4. Identify ventilation hazards and take corrective action
5. Observe and adhere to safety labels
6. Maintain, use and safely work with machines, tools and equipment
7. Obtain and use reference books and charts
8. Apply math to solution of welding problems - whole numbers, fractions, decimals, geometry and trigonometry
9. Identify basic hand tools
10. Select, use and care for hand tools
11. Use power machinery, grinder, drill press and power saw safely/correctly
12. Properly store electrodes and filler materials
13. Read and implement welding procedures
14. Identify basic power sources
15. Perform a weld test (destructive/nondestructive)

Other (specify):

B. Print Reading

1. Read and interpret basic prints
2. Interpret welding symbols, abbreviations and joint designs
3. Construct an exercise(s) using basic print and sketch
4. Make sketches - pictorial and orthographic
5. Interpret structural shapes, sizes and weights

Other (specify):

C. Oxy-Fuel Cutting/Welding

1. Demonstrate safety procedures
2. Identify types of fuels and their application
3. Handle, make preliminary safety inspection and store cylinders properly
4. Identify, select and set up oxy-fuel welding and cutting equipment
5. Light and adjust flame for welding and cutting
6. Pierce holes and cut slots
7. Make straight 90 degree and beveled cuts on mild steel plate and pipe
8. Make circle cuts - off hand and with guide
9. Layout, cut and fit pipe, plate and structural shapes
10. Run stringer bead without filler metal
11. Run stringer bead and joints with filler metal in flat position
12. Run stringer bead and joints with filler metal in horizontal position
13. Run stringer bead and joints with filler metal in vertical position
14. Run stringer bead and joints with filler metal in overhead position
15. Braze weld carbon steel
16. Braze weld cast iron
17. Prepare weld for testing and pass visual test
18. Identify welding and cutting problems, their causes and take corrective action
19. Identify and select correct welding/brazing rod

Other (specify):

D. Lay Out and Fit Up

1. Make layout of material for plate, structural and pipe fabrication
2. Prepare material for weld procedure

Other (specify):

E. Shielded Metal Arc - General

1. Demonstrate safety procedures
2. Describe theory of shielded metal arc welding
3. Identify and select power source and set current for weld procedure
4. Identify and make proper electrode selection for base material and material thickness
5. Identify joint design and prepare material for weld procedure
6. Identify welding problems, their causes and take corrective action
7. Build pad of beads in flat position with E-6010 or E-6011
8. Build pad of beads in flat position with E-7024
9. Build pad of beads in flat position with E-7018
10. Build pad of beads in horizontal position with E-6010 or E-6011
11. Build pad of beads in horizontal position with E-7018
12. Build pad of beads in vertical position with E-6010 or E-6011
13. Build pad of beads in vertical position with E-7018
14. Build pad of beads in overhead position with E-6010 or E-6011
15. Build pad of beads in overhead position with E-7018
16. Prepare weld for test ☆

Other (specify):

F. Shielded Metal Arc - 3/8" plate

1. Make weld in 1F position with E-6010 or E-6011 *
2. Make weld in 1F position with E-7024 *
3. Make weld in 1F position with E-7018 *
4. Make weld in 2F position with E-6010 or E-6011 *
5. Make weld in 2F position with E-7024 *
6. Make weld in 2F position with E-7018 *
7. Make weld in 3F position with E-6010 or 6011 *
8. Make weld in 3F position with E-7018 *
9. Make weld in 4F position with E-6010 or 6011 *
10. Make weld in 4F position with E-7018 *
11. Make weld in 1G position with E-6010 or E-6011 *
12. Make weld in 1G position with E-7024 (3 passes maximum) *
13. Make weld in 1G position with E-7018 *
14. Make weld in 2G position with E-6010 or E-6011 *
15. Make weld in 2G position with E-7024 (3 passes maximum) *
16. Make weld in 2G position with E-7018 *
17. Make weld in 3G position with E-6010 or E-6011 *
18. Make weld in 3G position with E-7018 *
19. Make weld in 4G position with E-6010 or E-6011 *
20. Make weld in 4G position with E-7018 *

Other (specify):

G. Shielded Metal Arc - Pipe (2" - 6" dia.)

1. Make weld in 1G position with E-6010 or E-6011 *
2. Make weld in 1G position with E-7024 (3 passes maximum) *
3. Make weld in 1G position with E-7018 *
4. Make weld in 2G position with E-6010 or E-6011 *
5. Make weld in 2G position with E-7024 (3 passes maximum) *
6. Make weld in 2G position with E-7018 *
7. Make weld in 5G position with E-6010 or E-6011 *
8. Make weld in 5G position with E-7018 *
9. Make weld in 6G position with E-6010 or E-6011 *
10. Make weld in 6G position with E-7018 *

Other (specify):

H. Shielded Metal Arc - 16 ga. steel

1. Make weld in 1F position with E-6010 or E-6011
2. Make weld in 1F position with E-7018
3. Make weld in 2F position with E-6010 or E-6011
4. Make weld in 2F position with E-7018
5. Make weld in 3F position with E-6010 or 6011
6. Make weld in 3F position with E-7018
7. Make weld in 4F position with E-6010 or 6011
8. Make weld in 4F position with E-7018
9. Make square butt weld in 1G position with E-6010 or E-6011
10. Make square butt weld in flat position with E-7018
11. Make square butt weld in horizontal position with E-6010 or E-6011
12. Make square butt weld in horizontal position with E-7018
13. Make square butt weld in vertical position with E-6010 or E-6011
14. Make square butt weld in vertical position with E-7018
15. Make square butt weld in overhead position with E-6010 or E-6011
16. Make square butt weld in overhead position with E-7018

Other (specify):

I. Gas Metal Arc Welding - Plate, Pipe (stainless steel, aluminum and carbon steel)

1. Demonstrate safety procedures
2. Identify, select and safely handle shielding gases for various transfer modes
3. Adjust current, voltage, wire feed rate and gas flow
4. Identify, select and set up equipment and explain functions
5. Identify and select solid wire electrode for carbon steel
6. Identify and select solid wire electrode for aluminum
7. Identify and select solid wire electrode for stainless steel
8. Identify types of cored wire electrodes for carbon steel and stainless steel
9. Select cored wire electrode for carbon steel
10. Build pad of beads in flat position with carbon steel--cored and solid wire (plate)
11. Build pad of beads in horizontal position with carbon steel--cored and solid wire (plate)
12. Build pad of beads in vertical position with carbon steel--cored and solid wire (plate)
13. Build pad of beads in overhead position with carbon steel--solid wire (plate)
14. Make weld in 1F position with carbon steel--cored and solid wire *
15. Make weld in 1F position with aluminum*
16. Make weld in 1F position with stainless steel *
17. Make weld in 2F position with carbon steel-cored and solid wire *
18. Make weld in 2F position with aluminum*
19. Make weld in 2F position with stainless steel *
20. Make weld in 3F position with carbon steel--cored and solid wire *
21. Make weld in 4F position with carbon steel--cored and solid wire *
22. Make square butt weld in flat position with carbon steel--cored and solid wire
23. Make square butt weld in flat position with aluminum
24. Make square butt weld in flat position with stainless steel

25. Make weld in 1G position with carbon steel--cored and solid wire *
26. Make weld in 2G position with carbon steel--cored and solid wire *
27. Make weld in 3G position with carbon steel--uphill *
28. Make weld in 3G position with carbon steel--downhill *
29. Make weld in 5G position with carbon steel--downhill (pipe) *
30. Make weld in 5G position with carbon steel--uphill (pipe) *
31. Make weld in 6G position with carbon steel (pipe) *
32. Identify welding problems, their causes and take corrective action
33. Prepare weld for test *

Other (specify):

____

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____

J. Gas Tungsten - Arc Welding (carbon steel, stainless steel, aluminum)

1. Demonstrate safety procedures
2. Identify, select and set up equipment and explain function
3. Identify, select and safely handle shielding gases
4. Identify, select, shape and install tungsten electrode
5. Adjust current, gas flow setting and post flow timer and strike arc
6. Identify joint design and prepare material for weld procedure
7. Select filler rod for base material
8. Build pad of beads in flat position
9. Build pad of beads in horizontal position
10. Build pad of beads in vertical position
11. Build pad of beads in overhead position
12. Make weld in 1F position, stainless steel *
13. Make weld in 1F position, aluminum *
14. Make weld in 1F position, carbon steel*
15. Make weld in 2F position, stainless steel *
16. Make weld in 2F position, aluminum *
17. Make weld in 2F position, carbon steel*
18. Make weld in 3F position, stainless steel *
19. Make weld in 3F position, aluminum
20. Make weld in 3F position, carbon steel
21. Make weld in 4F position, stainless steel *
22. Make weld in 4F position, aluminum *
23. Make weld in 4F position, carbon steel*
24. Make weld in 1G position, stainless steel *
25. Make weld in 1G position, aluminum *
26. Make weld in 1G position, carbon steel*
27. Make weld in 2G position, stainless steel *
28. Make weld in 2G position, aluminum *
29. Make weld in 2G position, carbon steel*
30. Make weld in 3G position, stainless steel *
31. Make weld in 3G position, aluminum *
32. Make weld in 3G position, carbon steel*
33. Identify welding problems, their causes and take corrective action
34. Prepare weld for test *

Other (specify):

____

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____

K. Plasma Cutting

1. Demonstrate safety procedures
2. Set up and operate plasma cutting equipment
3. Lay out and make straight line cuts on nonferrous metal
4. Lay out and make bevel cuts on nonferrous metal
5. Lay out and make circular cuts on nonferrous metal
6. Lay out and make pattern cuts on nonferrous metal
7. Lay out, cut and bevel pipe to a 30 - 37 1/2 degree angle on nonferrous metal
8. Lay out and cut square and round solid stock on nonferrous metal
9. Identify, select and safely handle cutting gases

Other (specify):

____

____

____

L. Metallurgy and Heat Treating

1. Demonstrate safety procedures
2. Identify the classification and physical properties of ferrous and nonferrous metals
3. Identify and apply principles of preheating and postheating
4. Describe and apply principles of metallurgy in annealing, hardening and tempering
5. Describe methods of testing metals
6. Identify types of ferrous metal by spark test
7. Describe the relationship between the hardness test of weld, heat affect zone and base metal, and interpret the results

Other (specify):

____

____

____

M. Carbon-Arc Cutting

1. Demonstrate safety procedures
2. Set up and operate carbon-arc cutting equipment
3. Remove weld material

Other (specify):

____

____

____

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* All welds in compliance with AWS-D1.1 or ASME Section IX Codes

Leadership Competencies **

1. Demonstrate an understanding of VICA, its structure and activities
2. Demonstrate an understanding of one's personal values
3. Perform tasks related to effective management skills
4. Demonstrate interpersonal skills
5. Demonstrate etiquette and courtesy
6. Demonstrate effectiveness in oral and written communications
7. Develop and maintain a code of professional ethics
8. Maintain a good professional appearance
9. Perform basic tasks related to securing and terminating employment
10. Perform basic parliamentary procedures in a group meeting

** (Note: These competencies are addressed in the Missouri VICA Curriculum Guide lessons.)

WELDING
ACCESS SKILLS CHECKLIST

Student Name/ID ______________________ Sending School ______________________

Instructor ______________________ Date(s) Evaluated ______________________

Circle proper mastery code: 3 = MASTERY 2 = REQUIRES SUPERVISION
1 = NOT MASTERED N or blank = NO EXPOSURE

TASK DESCRIPTION	TASK ID #	MASTERY CODE	MASTERY DATE	RETRY CODE/DATE
1. Count two-place numbers	480599A001	3 2 1 N		
2. Add two-place numbers	480599A002	3 2 1 N		
3. Subtract two-place numbers	480599A003	3 2 1 N		
4. Perform standard units of measurement, i.e., cup, pint, quart, inch, foot, yard, ounce, pound	480599A004	3 2 1 N		
5. Use basic measuring instruments, i.e., rulers, scales	480599A005	3 2 1 N		
6. Multiply two-place numbers	480599A006	3 2 1 N		
7. Divide two-place numbers	480599A007	3 2 1 N		
8. Add common fractions	480599A008	3 2 1 N		
9. Subtract common fractions	480599A009	3 2 1 N		
10. Multiply common fractions	480599A010	3 2 1 N		
11. Divide common fractions	480599A011	3 2 1 N		
12. Add two-place decimals	480599A012	3 2 1 N		
13. Subtract two-place decimals	480599A013	3 2 1 N		
14. Multiply two-place decimals	480599A014	3 2 1 N		
15. Divide two-place decimals	480599A015	3 2 1 N		
16. Lift 100 lbs. maximum with frequent lifting and/or carrying of objects weighing up to 50 lbs. (heavy work)	480599B001	3 2 1 N		
17. Bend body downward and forward by bending the spine at the waist (stooping)	480599B002	3 2 1 N		
18. Bend legs at the knees to come to rest on the knee or knees (kneeling)	480499B003	3 2 1 N		
19. Bend body downward and forward by bending the legs and spine (crouching)	480599B004	3 2 1 N		
20. Move about on the hands and knees or hands and feet (crawling)	480599B005	3 2 1 N		
21. Extend the hands and arms in any direction (reaching)	480599B006	3 2 1 N		
22. Seize, hold, grasp, turn or otherwise work with the hand or hands (handling)	480599B007	3 2 1 N		
23. Pick, pinch, or otherwise work with the fingers (fingering)	480599B008	3 2 1 N		

WELDING
ACCESS SKILLS CHECKLIST

Student Name/ID ____________________ Sending School ____________________

Instructor ____________________ Date(s) Evaluated ____________________

Circle proper mastery code: 3 = MASTERY 2 = REQUIRES SUPERVISION
1 = NOT MASTERED N or blank = NO EXPOSURE

TASK DESCRIPTION	TASK ID #	MASTERY CODE	MASTERY DATE	RETRY CODE/DATE
24. Perceive size, shape, temperature or texture of objects and materials by using fingertips (feeling)	480599B009	3 2 1 N		
25. Ability to work both inside and outside	480599B010	3 2 1 N		
26. Ability to work in extreme noise, constant or intermittent, causing marked distraction or possibly injury to hearing	480599B011	3 2 1 N		
27. Ability to work in extreme vibration, i.e., strain on body or extremities from repeated motion or shock	480599B012	3 2 1 N		
28. Ability to work in hazardous situations, i.e., risk of bodily injury	480599B013	3 2 1 N		
29. Ability to work in hazardous conditions, i.e., fumes, odors, toxic conditions, dust and poor ventilation	480599B014	3 2 1 N		
30. Coordinate eyes and hands or fingers rapidly or accurately (K-motor coordination)	480599C001	3 2 1 N		
31. Make a movement response accurately and swiftly (K-motor coordination)	480599C002	3 2 1 N		
32. Move the fingers and manipulate small objects with the fingers, rapidly or accurately (F-finger dexterity)	480599C003	3 2 1 N		
33. Move the hands easily and skillfully (M-manual dexterity)	480599C004	3 2 1 N		
34. Work with the hands in placing and turning motions (M-manual dexterity)	480599C005	3 2 1 N		
35. Performing repetitive work, or performing continuously the same work, according to set procedures, sequences, or pace	480599D001	3 2 1 N		
36. Situations requiring the precise attainment of set limits, tolerances, or standards	480599D002	3 2 1 N		
37. Identify basic hand tools and equipment	480599E001	3 2 1 N		
38. Use basic hand tools and equipment	480599E002	3 2 1 N		
39. Demonstrate knowledge of basic safety concepts	480599E003	3 2 1 N		

WELDING VOCABULARY LIST

ACETYLENE	a colorless, poisonous, highly inflammable, gaseous hydrocarbon (C_2H_2)
ALTERNATING CURRENT	a current that reverses its direction periodically
ALUMINUM	a silvery, lightweight, easily worked metal that resists corrosion
AMP (AMPERE)	the standard unit for measuring the strength of an electric current
ARC LENGTH	the distance from the end of the electrode to the location of workpiece contact
ARC WELDING	a process that unites or fuses metals by heating them with an arc between a covered metal electrode and the piece of metal being worked on
BASE METAL	the material to be welded, brazed, or cut
BEAD	a weld deposit resulting from a pass
BEVEL	an angular type of edge preparation
BRAZING	welding where a suitable filler metal is melted in a closely fitted joint between unmelted base metal parts and fills the joint by capillary action
CONDUCTOR	a thing or substance that transmits electricity
CURRENT	the flow or rate of flow of electrical force in a conductor
CYLINDER	a container used for transportation and storage of a compressed gas
DIRECT CURRENT	an electric current that flows only in one direction..
ELECTRODE	a filler metal used in arc welding, consisting of a metal core wire with a thick covering that provides protection for the molten metal from the atmosphere, improves the properties of the weld metal, and stabilizes the arc
GROOVE	the opening provided between two pieces of metal for a groove weld
GROUND CONNECTION	an electrical connection of the welding machine frame to the earth for safety

HIGH FREQUENCY	an alternating electric current with a frequency over 20,000 cycles per second
INERT GAS	a gas with few or no active properties
MILD STEEL	a steel that is tough but malleable and contains only a small percentage of carbon
OVERLAP	the protrusion of weld metal beyond the toe, face, or root of the weld
OXYGEN	a colorless, odorless, tasteless, gaseous chemical element (O) that is essential to life processes and combustion
PASS	a single progression of a welding operation along a joint
POLARITY	the condition of being positive or negative in relation to a magnetic pole
PUDDLE	the liquid state of a weld, prior to solidification as weld metal
REGULATOR	a mechanism for controlling or governing the flow of gases
REVERSE POLARITY	the arrangement of direct current arc welding leads with the work as the negative pole and the electrode as the positive pole of the welding arc
ROOT OF THE WELD	the point where the back of the weld intersects the base metal surfaces
SET UP	to prepare the metal (measuring, cutting, positioning, etc.) and the welding equipment (adjust dials, select positions, etc:) for a welding operation
SHIELD	to protect from atmospheric contamination
SILICON BRONZE	a filler metal that is an alloy of silicon, copper, and tin
SLAG	non-metallic solid material entrapped in weld metal or between weld metal and base metal
SPATTER	metal particles that are expelled during welding and do not form a part of the weld
STAINLESS STEEL	steel alloyed with chromium and other metals to be virtually immune to rust and corrosion

STEEL	a hard, tough metal composed of iron alloyed with various small percentages of carbon and other metals
STINGER	a slang term for an electrode holder in arc welding
STRAIGHT POLARITY	an arrangement of direct current arc welding leads in which the work is the positive pole and the electrode is the negative pole of the welding arc
TOE OF THE WELD	the junction between the face of a weld and the base metal
TORCH	a portable device for producing a very hot flame
TUNGSTEN ELECTRODE	a non-filler metal electrode made principally of tungsten
UNDERCUT	a groove melted into the base metal adjacent to the toe or root of a weld and left unfilled by weld metal
VALVE	any device in a pipe or tube that permits flow in one direction only or regulates the flow of whatever is in the pipe by means of a flap, lid, plug, etc. acting to open or block passage
WELD	a localized process of the uniting or fusing of metals or non-metals by heating the materials to a suitable temperature with or without pressure or use of filler material
WELD METAL	the portion of a weld that has been melted during welding
WELDING ROD	a form of filler metal used for welding or brazing which does not conduct the electric current
WORK LEAD	the electrical conductor between the source of arc welding current and the work

TOOL LIST FOR WELDING

Apron

Ball-Peen hammer

C-clamp

Chipping hammer

Electric Drill

Electrode holder

File

Gas wrench

Grinder

Hacksaw

Hammer

Helmet

Jacket

Large gloves

Open-end wrench

Phillips screwdriver

Pliers

Regular screwdriver

Sleeves

Spark lighter

Tip cleaner

Tongs

Wire brush

#10 lens

WELDING

Math Skills

Count two-place numbers
Add two-place numbers
Subtract two-place numbers
Perform standard units of measurement, i.e., cup, pint, quart, inch, foot, yard, ounce, pound
Use basic measuring instruments, i.e., rulers, scales
Multiply two-place numbers
Divide two-place numbers
Add common fractions
Subtract common fractions
Multiply common fractions
Divide common fractions
Add two-place decimals
Subtract two-place decimals
Multiply two-place decimals
Divide two-place decimals

NOTE: Many math books and workbooks provide needed direction in learning basic operations in math. This section assumes that students have basic skills and is designed to be used in conjunction with any of the math books you might be using, or to establish your own supplemental units. Any math practice activities should be developed within the context of the vocational program. Other persons to use as resources in this area include: parents, math teacher, and industrial arts teacher.

1. Given worksheet W #1 with pictures of gauges, student will count the numbers on the gauge until he/she reaches the number specified by the teacher. For example: The teacher asks the student to start at the zero point on the gauge and move up to 50. On the next gauge the student counts up to 25 etc.

2. Given worksheet W #2 with a number of weave welds, student will count the number of weaves accurately.

   Answers to weave counting:

   1) 70 2) 145

3. Given a tool box with a variety of sizes (1/8 etc.) rods (obtainable from the welding teacher), student will group rods by sizes and count the number in each group. (Be sure to have more than 9 in each group). Then ask student to add the total number of brazing rods in the box.

4. Given worksheet W #3 in which the welding machine is set on 150 amperes, student will subtract to find the number of amps to reduce the measure to the proper setting for each of the problems.

   Answers to Worksheet W #3

   1. 46
   2. 30
   3. 58
   4. 5
   5. 19
   6. 90
   7. 35
   8. 130
   9. 105
   10. 0

5. Given a board 4 x 6 inches, student will accurately measure 2" in from each side and 1" down from the top of the board to a centerpoint. Once the centerpoint is found, the student will select the appropriate drill to drill a hole 1/2" in diameter. This could also be accomplished by making posterboard or paper at the appropriate places as dictated by the teacher.

6. Given worksheet W #4 student will measure the exact distances on the design (including fractional parts) from one point to the other.

Answers to Worksheet W #4:

a) 5 15/16
b) 1 1/16
c) 1 15/16
d) 1 15/16
e) 11/16
f) 1/4
g) 11/16
h) 1/8
i) 5 1/16
j) 2
l) 3/4
m) 1 5/16
n) 3 1/8
o) 1
p) 1/4
q) 1 3/8
r) 3/8
s) 1 7/8
t) 5 15/16
u) 11/16
v) 13/16
w) 2 1/4

7. Given a series of math computations (developed by the teacher) student will accurately multiply two-place numbers to solve welding related problems. (For example: Your welding shop uses 15 pounds of welding rods per week. How many pounds are used per month? How many pounds per year?)

8. Given a worksheet (to be developed by teacher) with math computations, student will accurately divide two-place numbers. (For example: You have a 36" welding rod and need to make 12 small welds. How much of the rod can you use for each weld?)

9. Given objects to measure (pencils, paper clips, welding rods, etc.) student will accurately measure each to the correct fractional unit and then add the width of all objects combined.

10. Given welded materials of various sizes and shapes, (obtained from welding instructor) student will measure each to 1/16".

11. Given common fractions such as 1/2" student will divide the fractions into appropriate portions. For example: 1/2 ÷ 1/4 = ________
3/4 ÷ 1/8 = ________
Example: If you have a weld that is 1/8" and you need to know the half-way point, you would divide by 2, or 1/2 of 1/8 = ________.

SUGGESTIONS FOR PARENTS:

1. Encourage student to measure various items in the house.

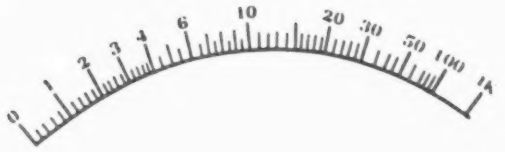
2. Work with student in converting fractions to decimals and vice versa (i.e., .75 = 3/4).

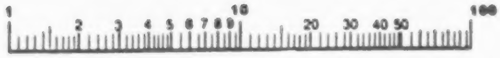
3. Provide opportunities for student to learn to read gauges, perhaps at home or through friends or neighbors who are familiar with various measurement devices.

W #1

WORKSHEET

READING GAUGES


0
1
2
3
4
6
10
20
30
50
100
1K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8
9
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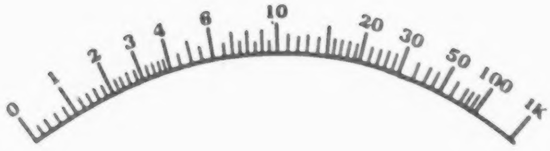
20
30
40
50
100


0
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6
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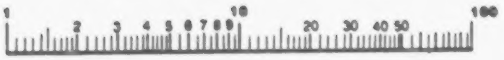
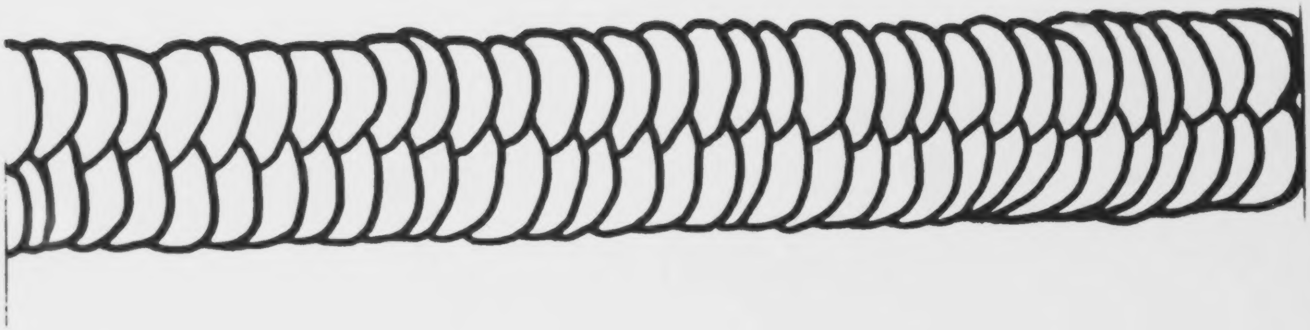
20
30
50
100
1K


1
2
3
4
5
6
7
8
9
10
20
30
40
50
100

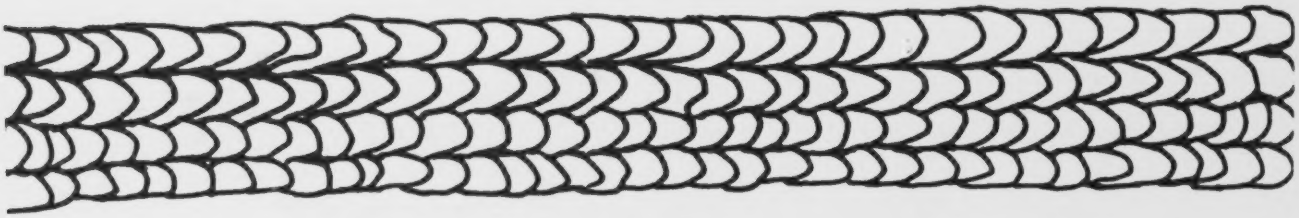
W #2

WORKSHEET

WEAVE COUNTING



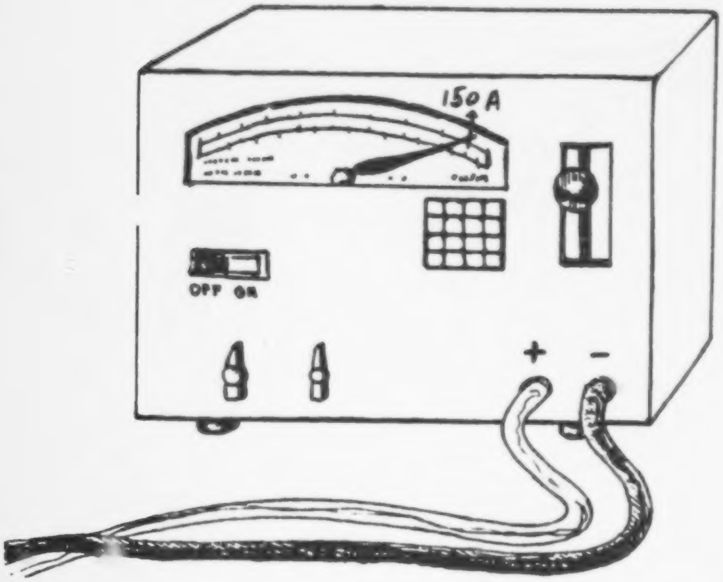
Number of weaves:_______________



Number of weaves:_________________

WORKSHEET

SUBTRACTION



Directions:

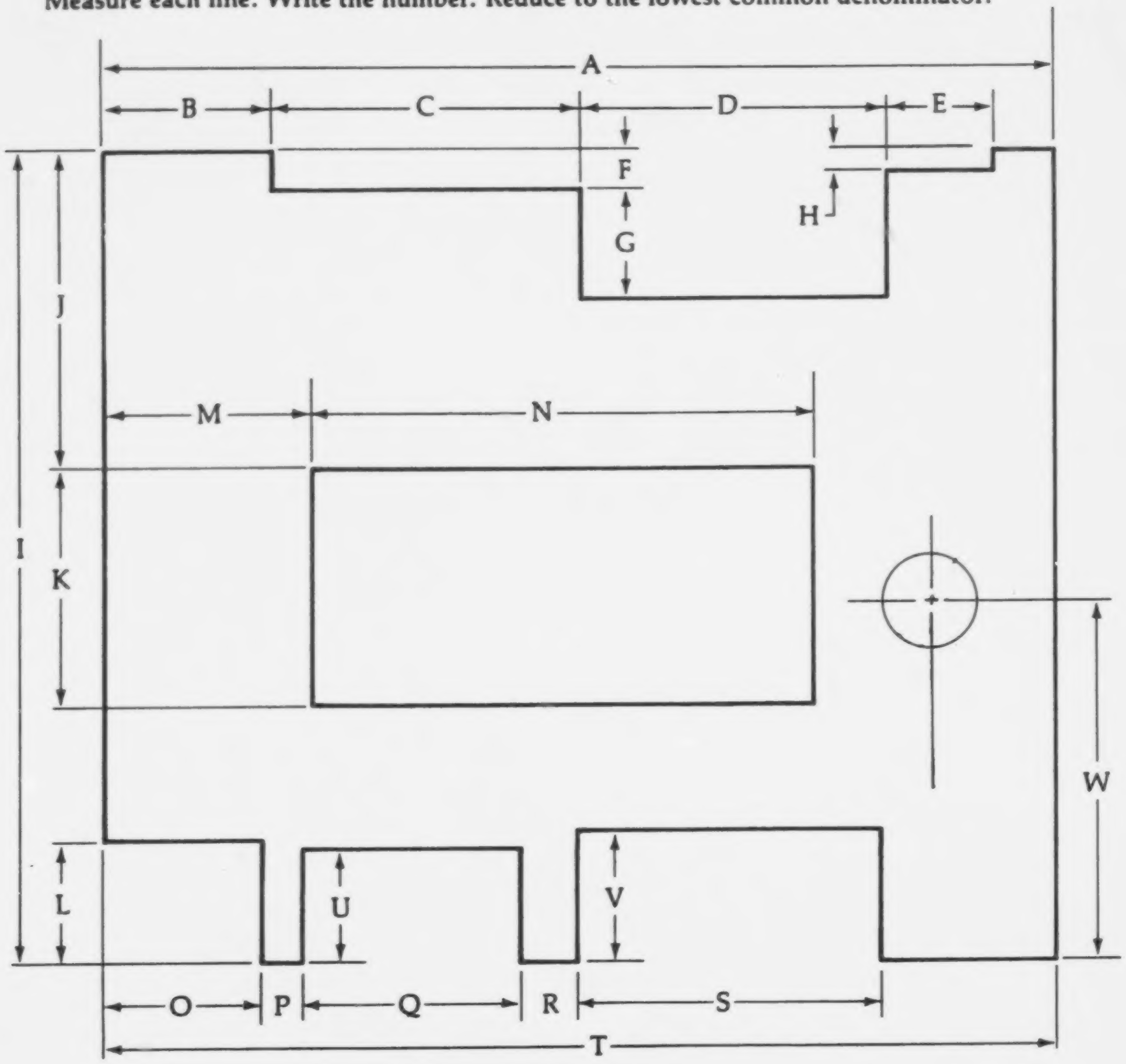
The welding machine above is set on 150 amperes. When doing different kinds of welding, the machine is set at different ampere levels. How many amperes would you need to subtract from 150 to get the following settings?

1. 104 amperes? ____________
2. 120 amperes? ____________
3. 92 amperes? ____________
4. 145 amperes? ____________
5. 131 amperes? ____________
6. 60 amperes? ____________
7. 115 amperes? ____________
8. 20 amperes? ____________
9. 45 amperes? ____________
10. 150 amperes? ____________

WORKSHEET

MEASUREMENTS

Measure each line. Write the number. Reduce to the lowest common denominator.


A
B
C
D
E
F
G
H
I
J
K
M
N
W
L
U
V
O
P
Q
R
S
T

A 5 15/16

B ________

C ________

D ________

E ________

F ________

G ________

H ________

I ________

J ________

K ________

L ________

L ________

M ________

N ________

O ________

P ________

Q ________

R ________

S ________

T ________

U ________

V ________

W ________

WELDING

Physical Demands/Working Environment

Lift 100 lbs. maximum with frequent lifting and/or carrying of objects weighing up to 50 lbs. (heavy work)
Bend body downward and forward by bending the spine at the waist (stooping)
Bend legs at the knees to come to rest on the knee or knees (kneeling)
Bend body downward and forward by bending the legs and spine (crouching)
Extend the hands and arms in any direction (reaching)
Seize, hold, grasp, turn or otherwise work with the hand or hands (handling)
Pick, pinch, or otherwise work with the fingers (fingering)
Perceive size, shape, temperature or texture of objects and materials by using fingertips (feeling)
Ability to work inside and outside
Ability to work in extreme noise, constant or intermittent, causing marked distraction or possibly injury to hearing
Ability to work in extreme vibration, i.e., strain on body or extremitites from repeated motion or shock
Ability to work in hazardous situations, i.e., risk of bodily injury
Ability to work in hazardous conditions, i.e., fumes, odors, toxic conditions, dust and poor ventilation

In most cases, the assessment of these skills will indicate that the student has the gross and fine motor skills which are prerequisites to learning the vocational skills in a Welding program. Prior to instruction in any physical demands activities, the student should have been evaluated and parents contacted to make sure that the student has no hidden physical problems that could be aggravated by lifting objects or by other physical activities done in this area. However, if the student has a physical disability or other limitation(s) preventing him/her from demonstrating fine and gross motor skills, then other techniques may be taught so he/she can perform in the vocational program. Other persons to use as resources in this area include: physical education teacher, industrial arts teacher, special education teacher, and parents.

1. Student will exhibit the ability to lift objects such as 20 lbs. of steel welding rods, and a small empty acetylene tank, or push several barrels of 100 lb. scrap metal with no complaints.

2. Given opportunities to lift heavy objects, student will accurately and safely bend body forward and at the knees to lift tanks, film projects, projection screens, and other heavy and awkward objects.

3. Given an unassembled object (example: small barbeque grill, child's tricycle, etc.) student will quickly and easily assemble the object by moving hands, small parts, and tools skillfully.

4. Given worksheet W #5 with 5 different sample completed welds, student will match welds to pictures by perceiving sizes and shapes accurately and be able to name each weld correctly.

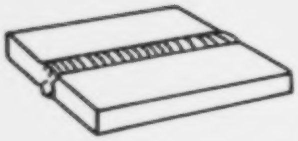
SUGGESTIONS FOR PARENTS:

1. Allow student to carry heavy objects (potting soil, etc.)
2. Give student directions and opportunities to put objects together - such as lawn mowers, wheelbarrows, etc.
3. Give student opportunities to wash car to learn body positioning.
4. Report on any allergies or medical conditions of the student.

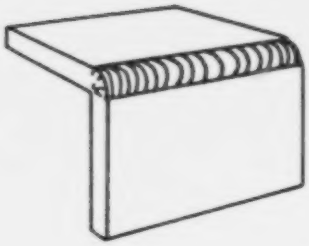
W #5

WORKSHEET

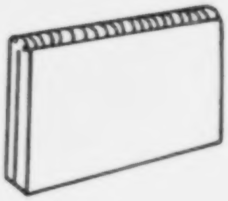
VISUAL PERCEPTION



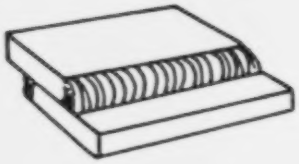
butt



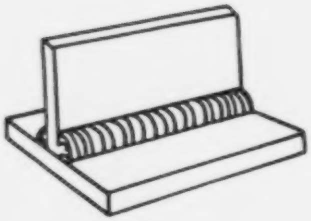
corner



edge



lap



tee

WELDING

Aptitudes - indicates an ability to:

coordinate eyes and hands or fingers rapidly and accurately (K-motor coordination)
make a movement response accurately and swiftly (K-motor coordination)
move the fingers and manipulate small objects with the fingers, rapidly or accurately (F-finger dexterity)
move the hands easily and skillfully (M-manual dexterity)
work with the hands in placing and turning motions (M-manual dexterity)

1. Given flux, soldering iron, and solder, student will accurately and neatly solder two pieces of metal objects in three of five attempts. Request industrial arts teacher or welding teacher to help provide guidance for this activity if necessary.

2. Given a rough board or piece of metal, safety goggles, and a wood or metal file, student will make smooth sweeping motions to remove all rough edges.

3. Given a variety of screws, washers and nuts, student will assemble them quickly and accurately.

SUGGESTIONS FOR PARENTS:

1. Give student opportunities to use a variety of tools to put small object together - small electronic toys or gadgets may provide student with opportunities to better develop finger dexterity skills.

2. Video games may provide student opportunities to improve eye hand movement.

3. Cutting boards to build small objects such as birdhouses might assist student to improve motor coordination and accuracy.

WELDING

Temperament - indicates an ability to adapt to:

performing repetitive work, or performing continuously the same work, according to set procedures, sequences, or pace
situations requiring the precise attainment of set limits, tolerances, or standards

1. Given a manual on beginning welding (obtained from welding instructor or library), student will accurately identify answers to questions regarding that material for a 20-30 minute period daily for two weeks without stopping his/her work.

2. Given worksheet W #6, student will use the chart to answer the questions with 100% accuracy.

   Answers to Worksheet #6:

   1. 18.84
   2. .0314
   3. 13
   4. 78.54
   5. 30.78
   6. 4.2
   7. 40.72
   8. 9.6
   9. 6.4
   10. 94.24

3. Given an order (from the teacher) for the student to complete certain projects by a certain time, student will check work for accuracy and completion and meet deadlines.

SUGGESTIONS FOR PARENTS:

1. Given a task to complete by a certain time, (example: a cleaned garage by Saturday noon) student will follow through completely without prompts or arguments.

2. Establish a routine for tasks to be completed on a daily or weekly basis. Allow student to assume responsibility for outcome of either task completion or noncompletion.

3. Give student written or oral directions for a step-by-step process to use when performing tasks at home - such as each step to follow in order to do the weekly laundry, steps to take to prepare the lawn for fertilizing, etc.

WORKSHEET

CHART READING--CIRCUMFERENCES AND AREAS

Diameter	Circum.	Area	Diameter	Circum.	Area
0.2	0.628	0.0314	7.2	22.61	40.72
0.4	1.26	0.1256	7.4	23.24	43.01
0.6	1.88	0.2827	7.6	23.87	45.36
0.8	2.51	0.5026	7.8	24.5	47.78
1	3.14	0.7854	8	25.13	50.27
1.2	3.77	1.131	8.2	25.76	52.81
1.4	4.39	1.539	8.4	26.38	55.42
1.6	5.02	2.011	8.6	27.01	58.09
1.8	5.65	2.545	8.8	27.64	60.82
2	6.28	3.142	9	28.27	63.62
2.2	6.91	3.801	9.2	28.9	66.48
2.4	7.53	4.524	9.4	29.53	69.4
2.6	8.16	5.309	9.6	30.15	72.38
2.8	8.79	6.158	9.8	30.78	75.43
3	9.42	7.069	10	31.41	78.54
3.2	10.05	7.548	11	34.55	95.03
3.4	10.68	8.553	12	37.69	113
3.6	11.3	10.18	13	40.84	132.7
3.8	11.93	11.34	14	43.98	153.9
4	12.57	12.57	15	47.12	176.7
4.2	13.19	13.85	16	50.26	201
4.4	13.82	15.21	17	53.4	226.9
4.6	14.45	16.62	18	56.54	254.4
4.8	15.08	18.1	19	59.69	283.5
5	15.7	19.63	20	62.83	314.1
5.2	16.33	21.24	21	65.97	346.3
5.4	16.96	22.9	22	69.11	380.1
5.6	17.59	24.63	23	72.25	415.4
5.8	18.22	26.42	24	75.39	452.3
6	18.84	28.27	25	78.54	490.8
6.2	19.47	30.19	26	81.68	530.9
6.4	20.1	32.17	27	84.82	572.5
6.6	20.73	34.21	28	87.96	615.7
6.8	21.36	36.32	29	91.1	660.5
7	21.99	38.48	30	94.24	706.8

DIRECTIONS: Use the chart above to answer the questions.

1. A piece of metal has a diameter of 6. What is the circumference? ________
2. A welding rod has a diameter of .2. What is the area? ______________
3. A piece of metal has an area of 132.7. What is the diameter? ________
4. If a circumference is 31.41, what is the area? _____________
5. If a diameter measures 9.8, what is the circumference? ______________
6. If an area measures 13.85, what is the diameter? ________________
7. If a circumference is 22.61, what is the area? ________________
8. If an area measures 72.38, what is the diameter? ________________
9. If a circumference measures 20.1, what is the diameter? _____________
10. If an area measures 706.8, what is the circumference? ______________

WELDING

Vocational

Identify basic hand tools and equipment
Use basic hand tools and equipment
Demonstrate knowledge of basic safety concepts

1. Given pictures of basic shop tools (worksheet W #7) student will accurately identify each.
2. Given pictures of gas and arc welding tools, (worksheet W #8) student will accurately identify each.
3. Given a list of actual tools to be used for a project, student will go to the appropriate location in the classroom or school to obtain those tools.
4. Given a simple project (example: file a rough piece of wood) student will gather all appropriate tools (including safety goggles) and complete the project accurately.
5. Given worksheet W #9, student will study the picture and be able to identify the parts labeled when asked.

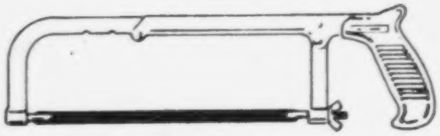
SUGGESTIONS FOR PARENTS:

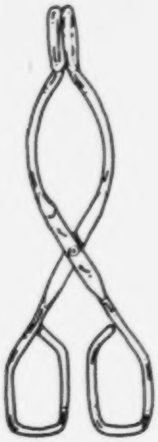
1. At any possible opportunity, allow student to use basic hand tools to perform a task - such as minor repairs, replacing screen or storm windows, changing oil and filter on cars etc.
2. Discuss safety concepts and ask student to report any hazards to you.
3. When working on a project, ask student for assistance by allowing him/her to select appropriate tools (in their appropriate size) for the task.

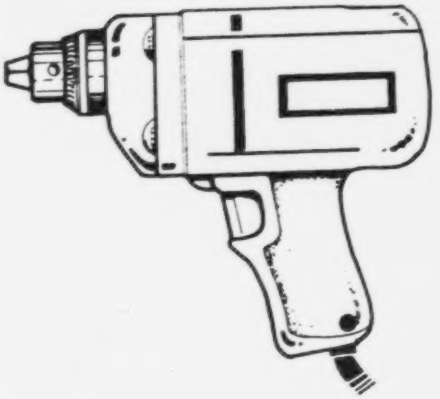
W #7

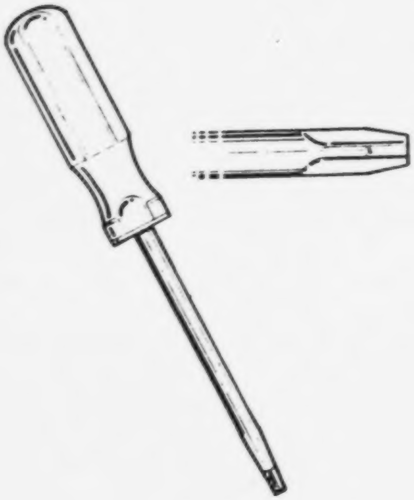
WORKSHEET

TOOL IDENTIFICATION

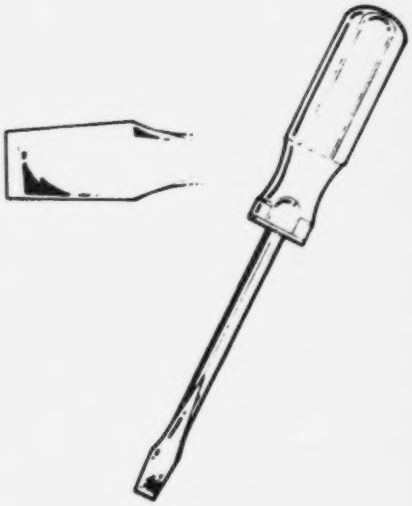

Hacksaw


Tongs


Electric drill


Phillips
Screwdriver

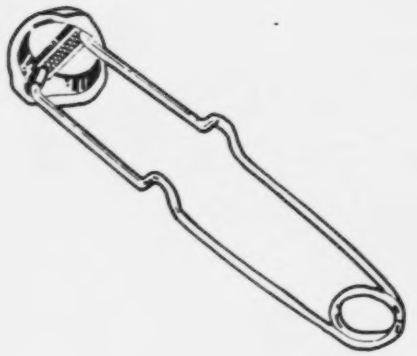
File

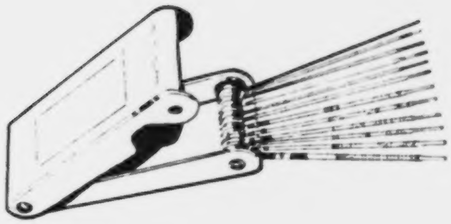

Regular
Screwdriver

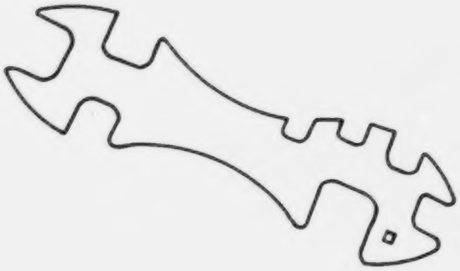
W #8

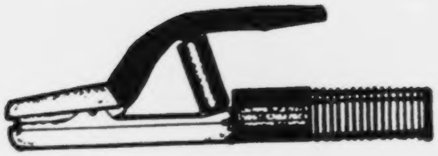
WORKSHEET

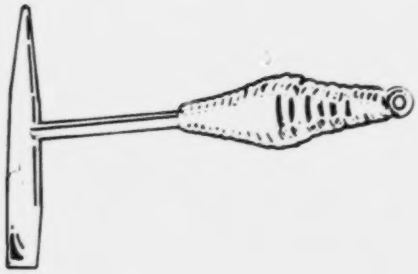
WELDING TOOLS

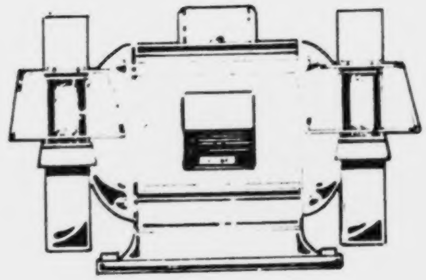

Spark lighter


Tip cleaner


Gas wrench


Electrode holder


Chipping hammer

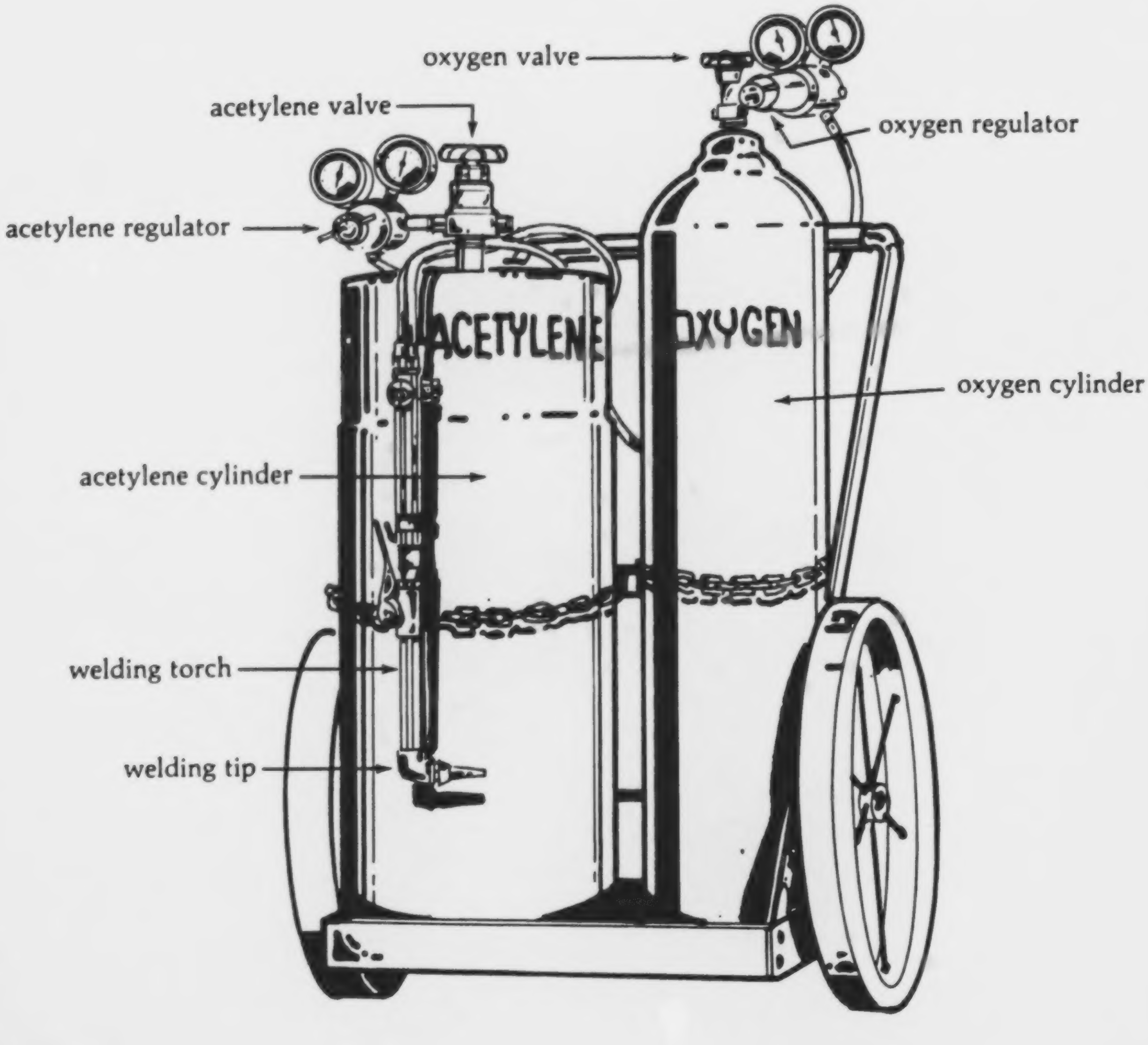

Grinder

WORKSHEET

GAS WELDING

Directions:

Study the picture. Cover the parts names and see if you can remember each of them.


oxygen valve
acetylene valve
oxygen regulator
acetylene regulator
ACETYLENE
OXYGEN
oxygen cylinder
acetylene cylinder
welding torch
welding tip

RESOURCES

The Alemany Press
2501 Industrial Parkway West
Hayward, CA 94545

Welding, West, L.

Instructional Materials Laboratory
908 Woodson Way
University of Missouri - Columbia
Columbia, MO 65211
1-800-392-7217

Special Needs Welding: Supplementary Units
Vocational Preparation Curriculum: Welding, Usors, H.

McKnight Publishing Company
809 W. Detweiller Drive
Peoria, IL 61615

Metalwork: Technology and Practice, Repp, V.; McCarthy, W.; and Ludwig, O.

INSTRUCTIONAL MODULE

VOCATIONAL AREAS:
All Trade and
Technical Areas

ACCESS SKILL: DEMONSTRATE SAFETY PROCEDURES FOR VARIOUS ACTIVITIES

TASK ANALYSIS STEPS: A-J

ACTIVITY	MATERIALS/RESOURCES
TASK A: Student will identify and define "safety" and "emergency".	
1. The teacher directs the lesson on safety by asking if the students understands "safety." If taught in a group, the students could break into small groups to define safety and give an example of it. Explain to the students that they are responsible for their own safety and that is why they are to learn about it in this lesson.	
2. Ask some "What if" questions. For example: What if you were told to climb a ladder and you didn't know how to set it up, what would you do? What if you were to cut up a salad where you work and you had never worked with a knife before, what would you do? These are things the students will learn in this lesson.	
3. Define "safety" as the state of being safe. Explain it to the students further by saying that it is when you are not in danger, you are safe. Write "safety" on the board.	Chalk, chalkboard
4. Define "emergency" as a sudden important happening or accident. Ask the students if they know what emergency means and ask them to give an example of an emergency. Make sure each student understands both definitions before moving on. Write "emergency" on the board.	Chalk, chalkboard
5. Individually ask each student to identify "safety" and "emergency."	
6. You might also want to add to the students definition the word "accident" and define it. Explain to the students that more than half of the accidents occur in the home--a place we would consider safest.	
TASK B: Student will discuss safety procedures of which he/she is presently aware.	
1. Explain to the students that the purpose of this lesson is to see how many safety procedures he/she is currently aware of.	
2. Ask students to write about, tell about, or role play with another student a safety procedure he/she is aware of. For example: When climbing do not stand on a chair, but use a ladder. Do not keep matches over a stove. Do not put your hand or other objects on a hot stove or in hot water, etc.	
3. Once students have exhausted their knowledge of safety procedures, identify other areas such as proper ways to lift, bend, push, pull, cut with a knife, use power tools, use hand tools, properly erect a step ladder and climb, read and understand safety instructions.	
4. Invite guest speakers to demonstrate the proper methods of performing the above skills safely. Have the students report on each one if they are already aware of the safety precautions necessary.	Guest speakers Worksheet B4

ACTIVITY	MATERIALS/RESOURCES
TASK C: Student will identify various situations in which it is necessary to know the proper safety techniques.	
1. Introduce lesson by discussing with the students that it is important to know the proper safety techniques to use in various situations. Ask the students if they can identify some of these situations. (This might be a review for some students, but some may come up with some new ideas.)	
2. Invite a guest speaker from the Fire Department, Health Department, First Aid or Red Cross Agency, or a safety administrator in a local business to speak to the group on safety precautions that are taken on the job and those the students must take on their own.	Guest speaker
3. Give the students newspapers and magazines and ask them to identify various situations in which an accident could have been prevented if someone would have used the proper safety precautions. Have them cut out pictures or articles about an accident and tell the proper safety procedures which should have been used.	Newspapers, magazines
4. Discuss with students safety procedures we see each day, such as stop signs, traffic lights, one-way signs, etc. Sometimes in cafeterias we see signs which tell us that a microwave oven is in use. What difference does that make? Elicit from the students the purpose behind some of these common warnings that they might take for granted.	Pictures of signs
5. Assign the students a person to watch and report about. Tell the students to watch the person for at least ten minutes and see how many situations he/she used proper safety procedures in and how many he did not. They should also tell what the person was doing and how to remedy the situation if it needed to be remedied. For example, one student might be assigned to watch the school janitor after school to see what he/she does and then write a report on what he/she saw.	
6. In talking about safety in various situations you might discuss job safety. What kinds of jobs are most dangerous and why? Students could be assigned a small research project regarding the amount of danger involved in the occupations in which they are interested. They could then discuss, write, or role play ways in which they could be safe should they decide to take that job. Don't forget to discuss small things like wearing gloves when cleaning ovens, walls etc., especially if they are working in a job which does a lot of cleaning.	
TASK D: Given various situations the student will become familiar with the safety procedures involved.	
1. Introduce the lesson by telling the students that they will become familiar with various safety procedures and actually demonstrate them during this portion of the lesson.	
2. Begin with showing the students proper and improper techniques for lifting and moving objects. Explain that there are proper and improper ways to lift objects. After demonstrating the proper methods have each student do so. (Sometimes feeling the difference is necessary, therefore the demonstration of movement in each is necessary.) See examples on Worksheets D2 and D2a.	Worksheets D2, D2a

ACTIVITY	MATERIALS/RESOURCES
TASK E: Given basic first aid training the student will become familiar with some of the safety procedures involved.	
1. Introduce to the students the following lesson by asking how many of them know anything about first aid. Any of the students who know first aid might want to act as an aide after having had their procedures checked out by the teacher for accuracy.	
2. Borrow books on first aid from the American Red Cross Agency. Give each student a copy of the book and cover the most important parts. For example: Poison - What to do if someone swallows a bottle of aspirin or eats a poisonous substance and doesn't know it, etc. (Check with the poison control center in your location for more information.) You might also cover auto accidents, broken bones, burns, falls, fevers, seizures, lacerations, bites, etc.	Basic First Aid from the American Red Cross Agency, Boy Scouts of America Handbook and Merit booklet on first aid
3. The American Red Cross has several films which emphasize particular portions of the Basic First Aid book. These are especially helpful for the student who learns visually and can associate.	
4. Give the students various situations and ask what they would do in that instance to determine if they have accurately picked up the necessary first aid skills. For example: If a person has fallen down over the side of a hill you should? a. tell him to get up and walk. b. tell him to stay calm and not to move. c. move all of his limbs to see if they are broken. Answer: b	
5. Teach the students to get help as soon as possible and to not leave the injured person unless absolutely necessary.	
6. Review with the students how to reach an ambulance (call 911).	
7. Teach students how to deal with wounds and lacerations: a. stop the bleeding b. protect the wound from getting dirty or infected c. keep the person warm and lying down d. get help	Use the American Red Cross First Aid book for details
8. Ask the students what they think they should do if they get something in their eye. Demonstrate how to treat an eye injury. a. keep the person from rubbing his eye b. wash your hands and check his eye by pulling the eyelid away if necessary c. don't try to get something out of the eye with any other object d. get him to a doctor as soon as possible e. if it is a chemical burn you will need to follow the safety instructions on the container which usually say to wash the eye. In this instance you run a gentle stream of water over the eyeball with the eye open for a specified period of time (usually 10-15 minutes).	
9. Invite a guest speaker from the American Red Cross Agency to demonstrate how to make bandages and dressings for identified injuries (broken bones, cuts, etc.).	Guest speaker

ACTIVITY	MATERIALS/RESOURCES
TASK E: CONTINUED	
10. Visit a hospital emergency room and ask the emergency medical technicians to demonstrate moving an injured person by pulling the person, one-man lift, two-man lift, and six-man carry. They might also demonstrate fore-and-aft carry and how to carry someone using a blanket.	Field trip to an emergency room
11. Discuss burns and the varying types (sun, chemical, water, electrical, etc.). Review the signs and symptoms for burns and what to do for them. (Keep the patient covered, comfortable, and moistened.)	
12. Using the American Red Cross First Aid book review the procedures for giving CPR. If it is felt that this is necessary for your students ask one of the CPR instructors from the American Red Cross to do the training. CPR is a special procedure and requires specific training in order to teach it.	CPR instructor
13. Assign the student(s) the task of calling Tel-Med in order to find out more about other first aid training. Require them to report to the class what they have learned. Be sure to check the students after each segment of the first aid training. *Note: Because first aid training could take a full year to teach, select the areas of training which best fit the needs of your student(s) and teach practical skills - symptoms and treatments.	
TASK F: Student will distinguish between types of knives and the safety procedures for using knives.	
1. Discuss with the students the objective of this lesson - varieties of knives and how to use them safely.	
2. Remind students that knives are not acceptable at school and ask if they know why. (Because they are dangerous.)	
3. Ask students to identify various knives they are familiar with (pocket, kitchen, steak, dinner, slicing, paring, etc.). Ask the students if they are familiar with these and if they have ever used any of them. One at a time introduce the knives to the students and demonstrate the proper use of each. Remind students to always cut away from themselves so that if the knife should slip they would not be cut. (If you do not have access to each of these types of knives use the pictures on Worksheet F3 to show students examples.)	Worksheet F3
4. Show students not only how to use the knives, but also how to safely carry knives--carrying it by the handle with the blade down and the sharp edge facing behind them. Tell them to carry it out to the side, but not so far that they would hurt someone who might walk beside them. Have the students demonstrate this using a wooden or plastic knife until safe procedures are completely learned.	Knives
5. Using a paring knife demonstrate the proper way to cut food --on a cutting board, pressing down on the knife blade with one hand and firmly holding the handle with the other, remembering to keep all fingers and other body parts out of the way. Allow each student a chance to demonstrate the	Paring knife, cutting board, vegetables

ACTIVITY	MATERIALS/RESOURCES
TASK F: CONTINUED	
safe procedure. Discuss with the students why we use a cutting board vs. our hand or the counter top. Remind students that a cutting board gives us a good solid surface, protects counters, and usually keeps objects from slipping as they might on a counter. We should never hold an object in our hand to cut, because we might cut our hand.	
6. Demonstrate the safe way to open a pocket knife by laying it on its side on a flat surface and holding it down firmly with one hand. Gently open the blade to the first notch. Once it is opened that far you may turn it up or leave it as it is and open it the rest of the way. Remind students to always close the knife as soon as they are finished using it. Show them the proper way to close the knife. Once again place the knife on its side on a flat surface and firmly hold in place with one hand while closing the knife with the other hand.	Pocket knife
TASK G: Student will demonstrate the safety procedures for using power tools.	
1. Introduce the lesson by pointing out to the students that safety is always their responsibility and accidents are always painful to the victim and to others around him/her.	
2. Ask the students to name a few power tools they are familiar with (drill, electric saw, etc.). Ask them to tell the safety procedures they are familiar with in using these tools.	
3. Invite the shop teacher in to talk to the students about shop safety--especially regarding power tools. If the shop teacher cannot make a guest appearance, perhaps a senior student who is very competent and is checked out by the shop teacher would like to demonstrate the safety procedures.	Guest speaker and shop tools
4. Use the rules on Worksheet G4 to reinforce the need for safety procedures when using power tools.	Worksheet G4
5. Ask the students to each think of another rule about using power tools and list them on the board. Then combine all of the lists together on one sheet. Assign the students to take the list home and ask their parents for other safety precautions that were possibly forgotten in the class.	Chalk, chalkboard
6. Show the movie "Safety in the Shop: Basic Practices" which demonstrates safety in using both power and hand tools in both wood and metal shops. Ask students to discuss the rules they learned from the movie which they had overlooked in previous assignments. Add this list to the list made in Activity 5 and assign a group of students to make a special bulletin board with all of the rules displayed.	"Safety in the Shop: Basic Practices"
TASK H: Student will recognize and identify hot surfaces and demonstrate ways to keep oneself and others safe from hot water and hot surfaces.	
1. Introduce the lesson to the students by asking them to name some "hot" things they are familiar with which might burn them. Ask them to think of as many as possible. (They	

ACTIVITY	MATERIALS/RESOURCES
TASK H: CONTINUED	
might name stoves, ovens, furnaces, hot water pipes, fireplaces, cigarettes, metal exposed to sunshine, motorcycle and other exhaust pipes, etc.)	
2. Discuss burns with the students and ask them to label some common causes of burns (carelessness with cigarettes or matches, scalds from hot liquids, use of strong chemicals, defective heating, cooking, electrical equipment, use of open fires, getting into overly hot bath water, etc.). Tell them that a burn is an injury which results from heat, chemical agents, or radiation (like from the sun), and it can cause serious illness, injury, or possible death.	
3. Bring into the classroom some of the above mentioned causes of burns (those which are safe to show), or show pictures of some of these burn causing agents. Ask the students to determine the reason these things might cause burns and how the burns can be prevented. For example, show the students a drawing of someone getting into a tub of steamy hot bath water and getting burned. Ask the students how that could be prevented. They might need to get into small groups to be sure they do not leave out any possible prevention methods. For examples see Worksheet H3.	Materials which show possible burn agents, pictures of burn causing agents or hot surfaces and/or Worksheet H3
4. Show the film "Kitchen Safety: Preventing Fires" and discuss grease fires and cleaning stove hoods and duct systems to keep them safe. Also discuss fires in deep fat fryers, grills, trash cans, and electrical equipment.	"Kitchen Safety: Preventing Fires" "Fire Prevention: In the Home" Both are available from the Academic Support Center at UMC
5. Discuss with the students that sometimes a burner doesn't look hot, but it is. We must know ways of checking hot surfaces without burning ourselves. Ask how many students are familiar with "hot wires." Explain to the students that these wires may not be hot to the touch, but could electrocute or burn a person if handled in the wrong way. We must therefore learn to handle the wires safely. Follow up with the movie "Fire Prevention: In the Home" which discusses fires in electrical outlets, and other danger spots such as the attic and basement.	
6. Cut several strips of paper and write various fire hazards on the paper. Ask each student to pantomime what they would do if they were injured in that way. Then ask another student to role play or tell ways that type of injury might be prevented. For example, a student might pull a slip of paper with the words "cigarette burn" written on it. The student would act out getting a cigarette burn--maybe by sitting in a chair and falling asleep with a make-believe cigarette in his/her hand. The other student would act out the part of prevention by simply putting out the cigarette before closing his/her eyes while sitting in the chair.	Strips of paper with fire hazards written on them
7. Invite someone from the Fire Department or a local restaurant to talk about fire safety and keeping oneself safe from burns or hot surfaces that could potentially burn.	Guest speaker
8. Ask students to list as many incidents as they can possibly think of in which someone might get burned. Have the students take the paper home and check with their parents to see if their home is safe from these burn possibilities.	

ACTIVITY	MATERIALS/RESOURCES
TASK I: Student will demonstrate the correct method for setting up and climbing a ladder.	
1. Introduce the lesson by showing the students a ladder or a picture of a ladder. Ask the students what a ladder is used for. Be sure everyone can identify a ladder and its use before going on. (Show straight and folding ladders.)	Ladder or picture of ladders
2. Explain to the students that a ladder is used for climbing. Ask why we can't just use chairs (some are too high, they are not safe or sturdy enough sometimes, etc.). Discuss possible hazards of using a chair for climbing. Discuss possible hazards of using a ladder. Point out to the students that the ladder must be in good repair.	
3. Invite a painter in to demonstrate how to prop a ladder against a building in order to paint. Point out that a straight ladder should be placed at a 70 degree angle with the ground. Ask why that is so important. (Students should respond with something to the effect that if the ladder is too far away, it can easily slip; if it is too close, the least change in the distribution on your weight at the top can cause it to topple backwards.) Do not demonstrate climbing and having this happen, but do allow each student to set the ladder up at a 70 degree angle to make sure they understand approximately what 70 degrees looks and feels like.	Guest speaker Straight ladder
4. Discuss with the students that when using a straight ladder you must make sure the ladder is the right length. If it is too short it could easily slip. It should generally be at least 3 feet above the roof to give you an extension to lean against so you don't fall. Show students pictures of ladders beside houses and have them select the ladder best suited for the job. Make sure they understand the ladder should be taller than the job needed.	Straight ladder
5. Ask the students what they would do if they set up the right length ladder at the right distance from the building, but they could not reach the whole side of the building from the ladder in order to paint the building. (Students will hopefully respond that they would have to get down from the ladder frequently in order to move it and not try to move the ladder by standing on it or not try to paint leaning way over.) Make sure the students understand the danger of stretching far to do a job while standing on a ladder.	
6. Bring in a step ladder and ask each student to set it up in the proper fashion (after a demonstration). Be sure to get a sturdy ladder and check the following: Is it in good repair? Does it have rubber tips to keep it from sliding on a slick floor? Do the hooks on the ladder work safely? Are there any cracks in any part of the ladder? Then, open the ladder, spread both sides evenly apart, hook each side snugly into place, and test the strength of the ladder by putting your weight on it (lifting your feet just off the floor). Then have the students climb the ladder with assistance if necessary. Finally have them climb down from the ladder (again, with assistance if necessary, but eventually alone). You might want to put each of these steps on a sheet and check off only the parts the student can do alone.	Folding step ladder Checksheet of ladder safety

ACTIVITY	MATERIALS/RESOURCES
TASK J: Student will read and understand basic safety instructions.	
1. Explain to the students that being able to read and understand safety instructions is important whether they are working in a shop, McDonald's, their own kitchen, or wiring a toy for a child for Christmas. Ask the students to think of places where they have had to read safety instructions and if they understood them. Usually instructions are given in a step-by-step format. If they are not, the student would want to break it down that way.	
2. Ask the students what they would do if they were to fix an electrical outlet and the first safety instruction on the directions was "never work on an electrical path or circuit until you have located and disconnected the master switch." Students may have trouble with some of the terms and may need pictures or actual experience going through the safety instructions, so show them the action on Worksheet J2 as a demonstration of following up that job. Give the students worksheets with safety instructions written on one side and pictures of those tasks on the other side. Have them match the picture with the proper safety instruction as on Worksheet J2.	Worksheet J2
3. Locate the safety instructions for various appliances in the classroom (tape recorder, language master, etc.) and ask the students to demonstrate the first safety instruction.	Safety instructions for applicances, etc.
4. Ask the students to report on their at-home activities telling something they learned that they hadn't known previously. Have the other students note all of the safety instructions of which they are now aware.	
5. Name a job to be done which would require safe action. Ask the students to write the safety instructions in a step-by-step process in order to show that they know how to safely use that object.	

Worksheet B4

Name ______________________________

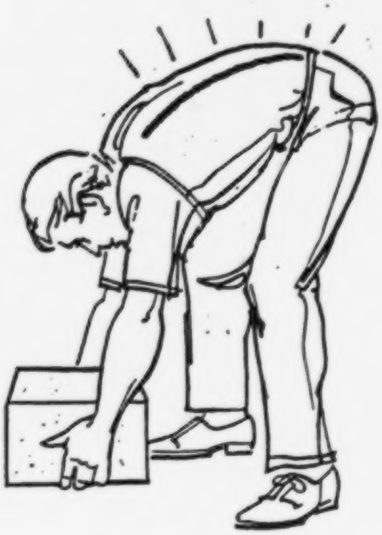
We practice the following safety procedures in my home:

_____ 1. Poisons are put out of the way of small children.
_____ 2. Cords are in good condition with no wires showing.
_____ 3. A smoke alarm is present and works.
_____ 4. My family has a practiced procedure for getting to safety in case of a fire or tornado.
_____ 5. Knives are kept in a safe place.
_____ 6. No toys, books, or other items are placed on the steps.
_____ 7. All of the hand tools in our house are used only by those who have shown they know how to use them safely.
_____ 8. Paper and old oily rags are kept out of areas where a potential fire might result.
_____ 9. Emergency phone numbers are kept by the phone at all times.
_____ 10. Whenever something breaks in my house, we fix it immediately so no one gets hurt.
_____ 11. We have a fire extinguisher that is in working condition and I know how to use it.
_____ 12. The household heating and air conditioning system is checked regularly for safety.
_____ 13. There are not curtains near our fireplace or stove.
_____ 14. We do not plug more than one thing in each electrical outlet.
_____ 15. No one smokes in bed or sets the ashtry on the couch or other flammable objects.
_____ 16. We have occasional home safety discussions.
_____ 17. We do not have wrinkles in our carpet which would possibly make someone fall.
_____ 18. We use a stepladder to reach high places.
_____ 19. We have good lighting in our house - especially on the stairs.
_____ 20. Whenever we spill something, we wipe it up before anyone has a chance to fall.
_____ 21. We keep rubber strips or adhesive strips in the bathtub.
_____ 22. We do not keep electrical appliances (like a TV or radio) on the edge of the bathtub.
_____ 23. We do not touch electrical things with our hands wet.
_____ 24. We do not keep medicines in the house after we have finished taking the necessary amount.
_____ 25. We do not falsely report an emergency.

Worksheet D2

LIFTING AN OBJECT

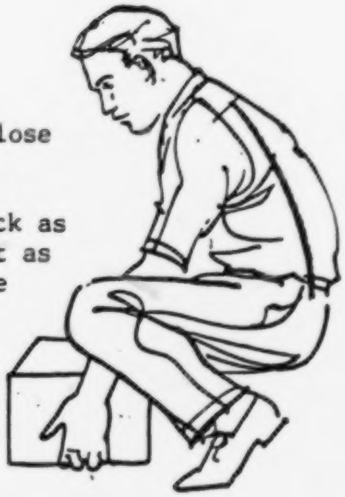
Incorrect Lifting Technique

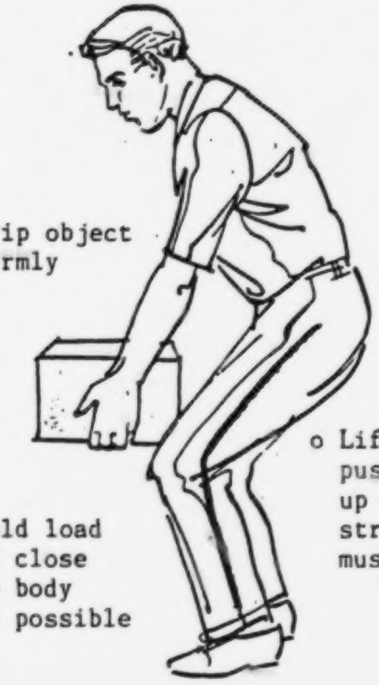


Lift with your leg muscles, not with your back, or your "muscle machinery" may be injured.

Correct Lifting Technique

- o Squat close to load
- o Keep back as straight as possible

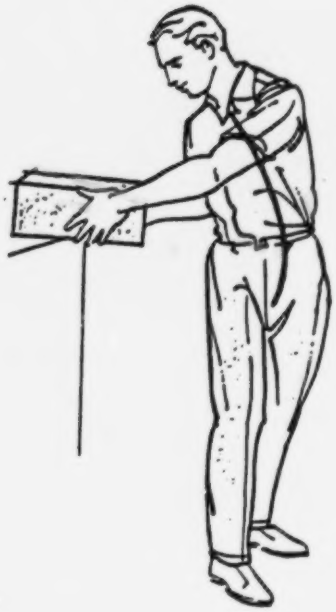




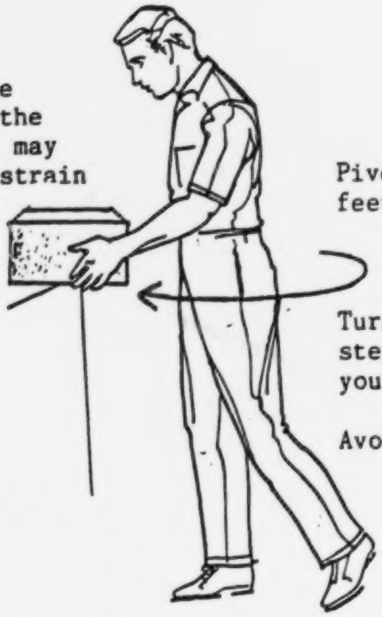
- o Grip object firmly
- o Hold load as close to body as possible
- o Lift by pushing up with strong leg muscles

Worksheet L2a

DIRECTION OF MOVEMENT



Twisting the back pulls the muscles and may cause back strain



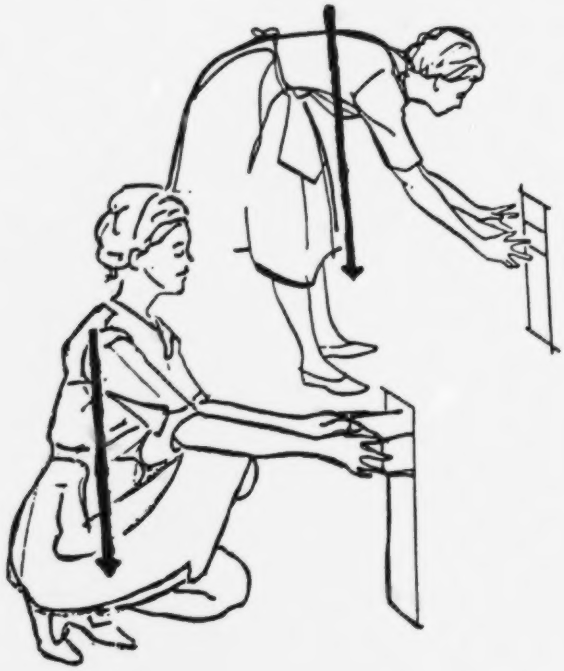
Pivot with your feet

Turn with short steps and turn your whole body

Avoid twisting

Let Your Legs do the Work . . . Not Your Back

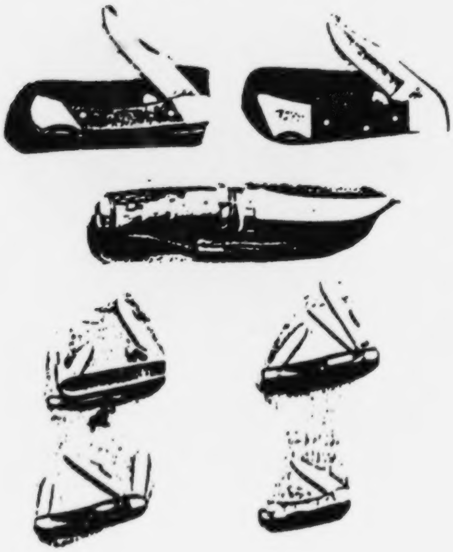
Kneel or squat . . . when you perform a job near the floor. Bend the knees instead of bending from the waist. This saves tiring or straining back muscles.



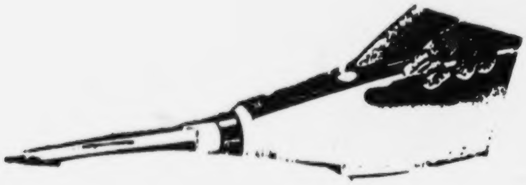
Worksheet F3

SAMPLE KNIVES

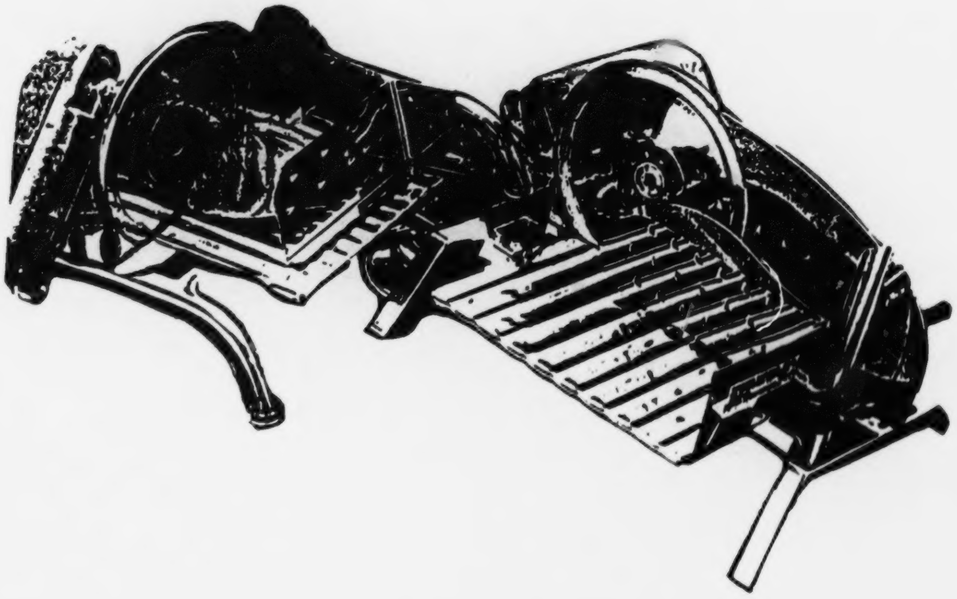
Pocket Knives



Electric Meat Slicer
or Slicing Knife

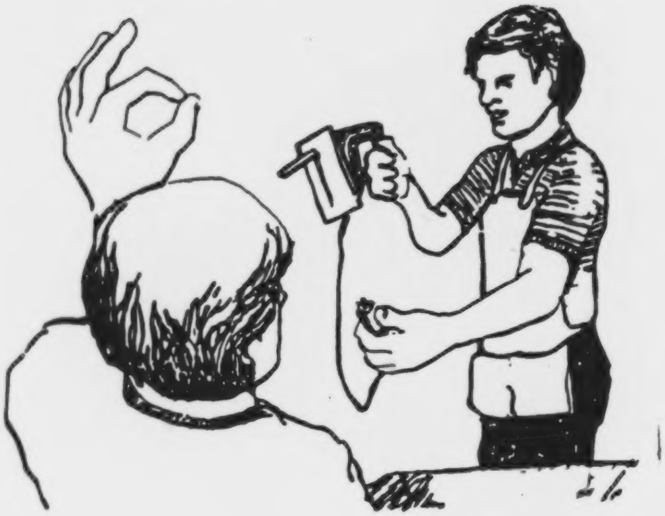


Electric Food Slicer

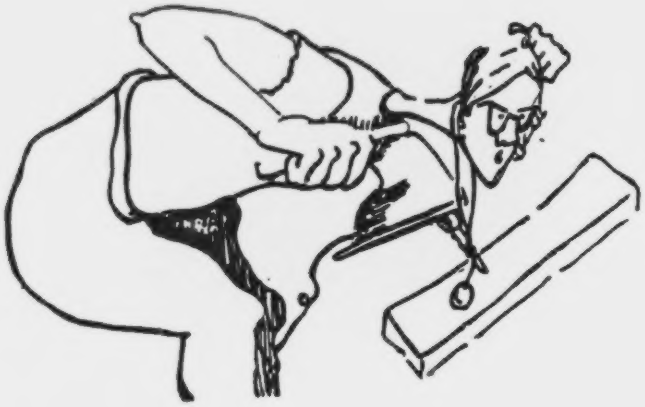


Worksheet G4

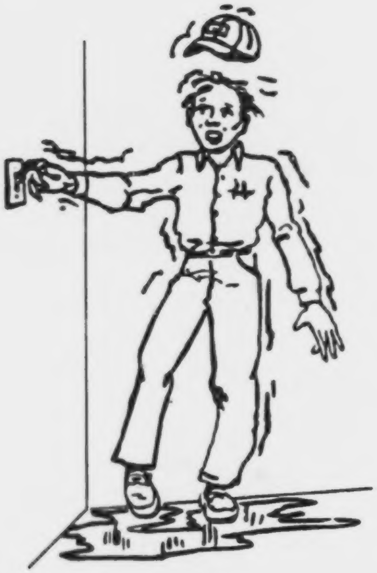
Operate power tools and equipment only after getting approval of the instructor.



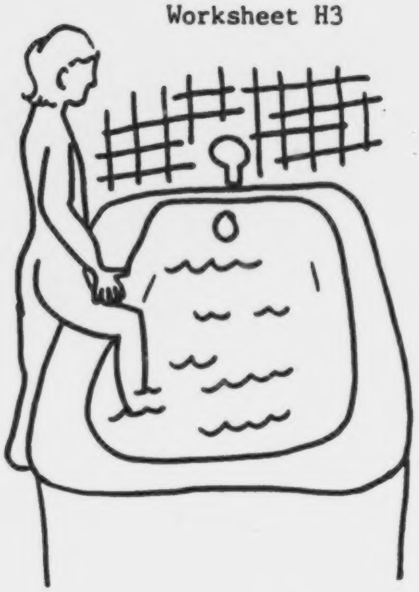
Never wear jewelry when operating power tools or machines.



NEVER switch an electrical device on or off when you are wet or while standing in water. Water conducts electrical current.

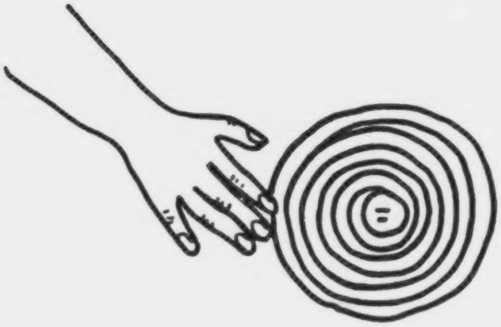


Worksheet H3



If the water you stepped into was too hot, what might happen?

What things could you do to prevent a burn from hot water?



Don't test a stove burner to see if it is hot by putting your hand on it. Check the controls on the stove to see if it's on and hold your hand 6-8" above the burner to feel the heat - not the burner.

What would happen if you put your hand on the burner even if it wasn't red hot?

What are some other safety measures you can take to keep yourself and others from being burned by a hot surface like a stove top?

INSTRUCTIONAL MODULE

VOCATIONAL AREA:
Auto Mechanics
Diesel Mechanics
Electronics
Welding

ACCESS SKILL: BECOME FAMILIAR WITH VOCABULARY PERTINENT TO THE APPROPRIATE VOCATIONAL SUBJECT

TASK ANALYSIS STEPS: A-B

ACTIVITY	MATERIALS/RESOURCES
TASK A: The student will recognize vocabulary necessary to successfully complete assigned tasks	
1. Students working in pairs or alone may prepare a notebook of appropriate vocabulary and definitions for each unit or an entire year. See Worksheet A1 for suggested requirements.	Worksheet A1 notebook, paper, textbook
2. At the beginning of each unit of study, use a transparency and overlay to identify appropriate sections of a piece of equipment or parts to be studied. After introducing essential vocabulary, remove the overlay and call on specific students to go to the screen to point to a part you select. Repeat the process until every student has identified a section or piece. Next day, distribute copies of the item with numbered lines for parts. Students write in the names of the appropriate parts. Collect papers. Project the transparency and overlay for reinforcement. See (transparency) Worksheet A2 and (overlay) A2a for an example.	Worksheet A2 (transparency) Worksheet A2a (overlay) Overhead projector Screen
3. Make a selected vocabulary list for a unit of study. Worksheet A3 provides an example. Divide students into groups. Distribute vocabulary list and large index cards. Divide the list as equally as possible. Assign each group to locate each word in the textbook or dictionary. Students neatly print the key word on one side of the large index card and the meaning on the opposite side. If the definition needs to be reworded for the students' comprehension, they rewrite it. Next, each group will appoint one speaker. The speaker from each group will teach the class each vocabulary word. Index cards are tacked to a bulletin board or taped to a wall. (Masking tape works well.) Next day, regroup students. Distribute vocabulary lists. Students write a definition for each word. Use the displayed cards to check the papers as a class. Students discuss and rewrite difficult or incorrect responses. Remove the cards from the display. Next day, on a plain sheet of paper, students write the correct vocabulary word as you read the definition from the card. Use all or part of the list.	Worksheet A3 Large index cards textbook or dictionary
4. Use real or model parts. For example, if you are working in welding, show the base metal, gap in seam, bead torch tip, welding rod, and puddle. Write a list of the vocabulary on the board. Use the textbook to identify specific parts. Be sure each student sees the part from the real or model item. Show a specific part, such as the puddle, to the class to identify. Students look up all vocabulary words they miss identifying in their textbooks.	
5. Write a mock purchase order for each student. Distribute the mock orders. Each student will sketch each part or trace it from the textbook. For example, a student might receive the following on a purchase order for a Bent-Axis Pump: piston, piston rod, cylinder, universal link.	Mock purchase order, unlined paper, textbook
6. Scramble a list of vocabulary words. Distribute the list and a list of definitions or pictures. Students unscramble the list and write each word to the left of the appropriate definition or picture. See Worksheet A6 for an example.	Worksheet A6

ACTIVITY	MATERIALS/RESOURCES
TASK A: CONTINUED	
7. Make copies of a picture of an item (such as a Bent-Axis Pump). Draw lines through the copies. Cut the copies to make a puzzle. (If you want to use the puzzle many times, laminate each piece or use clear contact paper over each piece and a piece of cardboard.) Give each student a puzzle to put together, Worksheet A7. After completing the puzzle, students label each appropriate part orally to the instructor. See Worksheet A7a.	Worksheet A7
8. Prepare a vocabulary list for review from the current unit of vocational study. Play hangman with the list. Divide class into two teams. Go only as far as arms and legs on the hangman. Keep a list of used letters on one side of the board for each game. If this is for an automotive class, a simple design of a car or a truck could be used instead of a stick figure of a person.	Blackboard, chalk, Vocabulary list from current unit of study
TASK B: Student will become familiar with concepts of vocabulary necessary to successfully perform assigned tasks.	
1. Cut pictures from magazines or old catalogs of items that use the vocabulary word. Paste each on an index card. Students explain how the key word, written on the board, is used in the item. For example, see Worksheet B1 and Worksheet A3. Students may refer to textbook. After students have adequately explained the vocabulary word for each picture, distribute copies of several pictures for students to write an explanation of the key word for each picture. After completion, students exchange papers, form small groups and discuss responses. Changes are made on students' papers. (Encourage students to write positive comments on papers.) After all papers have been discussed, return papers to owners. Allow time for students to read comments and to ask questions. Next day, write on the board: What purpose does the key word serve in each of the following? Using masking tape, place 3 to 5 pictures on the board and number each one. Students write responses for each picture. Collect papers. Students discuss assignment orally for reinforcement.	Worksheet B1 Worksheet A3 index cards, masking tape, blackboard, chalk, copies of items
2. Write the key words on the board. Students work in pairs to find explanations in their textbooks or dictionaries for each key word. After completion, pairs move into groups of four to compare responses. One member of each group explains one key word to the class.	Blackboard
3. On numbered index cards, write a fill-in item. Tell students there are x number of cards. Distribute one card to each student. Distribute one prepared answer sheet to each student. Place remaining cards on a front desk. As students complete a card using their textbook, they pass it to the next student. Cards from the front desk are used until each student has attempted every card. Papers may be collected for evaluation or checked together in class. If papers are collected, oral reinforcement is necessary. Read each card aloud and students call out responses. See Worksheet B3 for an example of items.	Prepared numbered index cards numbered answer sheets Worksheet B3 textbooks

ACTIVITY	MATERIALS/RESOURCES
TASK B: CONTINUED	
4. Word Rummy - Make a deck of cards from index cards. Laminate them or cover with clear contact paper. Write or print the key word on one card and the definition or concept on another. To play: Students deal five cards to each player. Place remaining cards in the middle of the group of up to four players. Student to the dealer's left begins by drawing the top card from the deck. To make a match, the key word and its correct definition must be used as a pair. If student has a match, he/she places the pair face up on his/her desk, draws again until no further match is made from that hand. If no match is possible, student discards one card from the hand and the next player continues. The winner is the student with the most correct matches. For disputes, students check textbooks for clarification.	Word list from unit in textbook index cards textbooks
5. Select a unit of study to be used in electronics, automotive repair, welding, etc. Students skim reading material in vocational textbook chapter. Students list unfamiliar technical words from the chapter. Each student chooses any ten unfamiliar technical words from the assigned chapter to write on 3" x 5" cards. On a master answer sheet, each student writes the word in alphabetical order with a sentence that defines the technical word. Each student writes his/her name on the back of each card. Students design an appropriate game board, for example, in electronics the game board might be designed as a particular circuit. Game board markers could be made from tag board or cardboard in the shape of items that use the circuit, part of car, tools used in welding, etc. Each student has three face-down cards from his/her vocabulary cards. Each student turns over one card, pronounces the word, and gives an appropriate technical definition. Student to the right checks accuracy of definition by reading the definitive sentence. If student gives correct response, he/she rolls die or a spinner could be used (circular cardboard divided into 6 equal sections with a hole and an upside down brad in the middle, color one split end of the brad for the spinner) to see how many places to move forward on the gameboard. Winner is the student who reaches the end first or the one who is closest to the end at the end of specified time. Students list the words at the end of the master answer sheet or on a record sheet, prepared by the instructor, which need to be learned. Accuracy of 70 percent or higher is the goal for each student in the first game. If new words are added, accuracy of 90 percent or higher should be attained.	Worksheet B6 tag board, felt tipped marker, scissors, 3 x 5 cards, master answer sheet of vocabulary definitions, die or spinner, check sheet, pencils
7. Use Activity 6 with a basic group of technical vocabulary words from the end of a unit in a vocational textbook, for example, or from two or three units of study to provide a review before a test or hands-on task.	

Worksheet A1

DIRECTIONS: Each student will prepare a notebook of vocabulary for this course. At the end of the semester, an open notebook test will be given. Notebooks will be collected for a project grade.

REQUIREMENTS: Write neatly and legibly in blue or black ink. Organize the notebook according to each unit of study. Within each unit, alphabetize each group of words. Sketch on unlined paper or photocopy appropriate items and correctly print the name of each part.

CAUTION: Do not photocopy items and labels. Print the labels. Keep the organized vocabulary in a looseleaf notebook. On the front cover, write your name, class, and instructor's name.

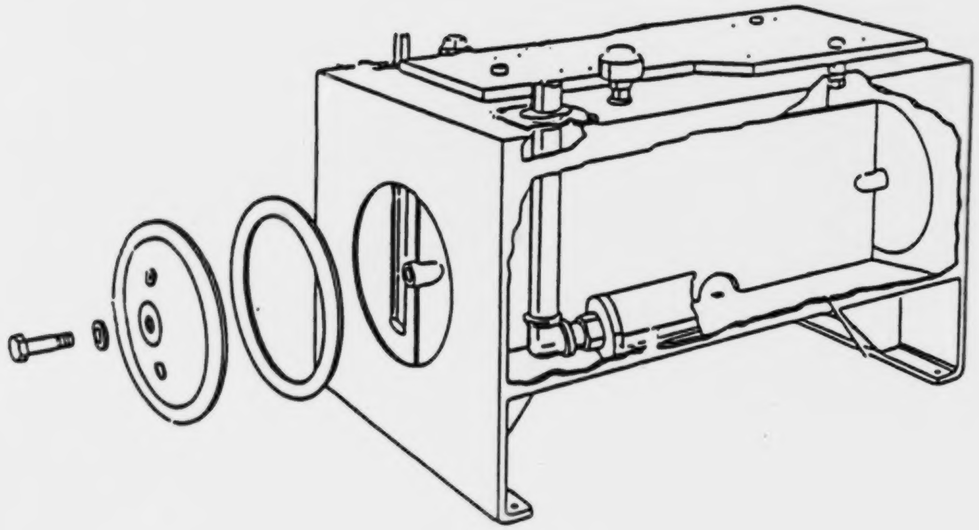
TESTING AND COLLECTION DATE: ____________________________

POINTS POSSIBLE FOR: Test __________

Notebook __________

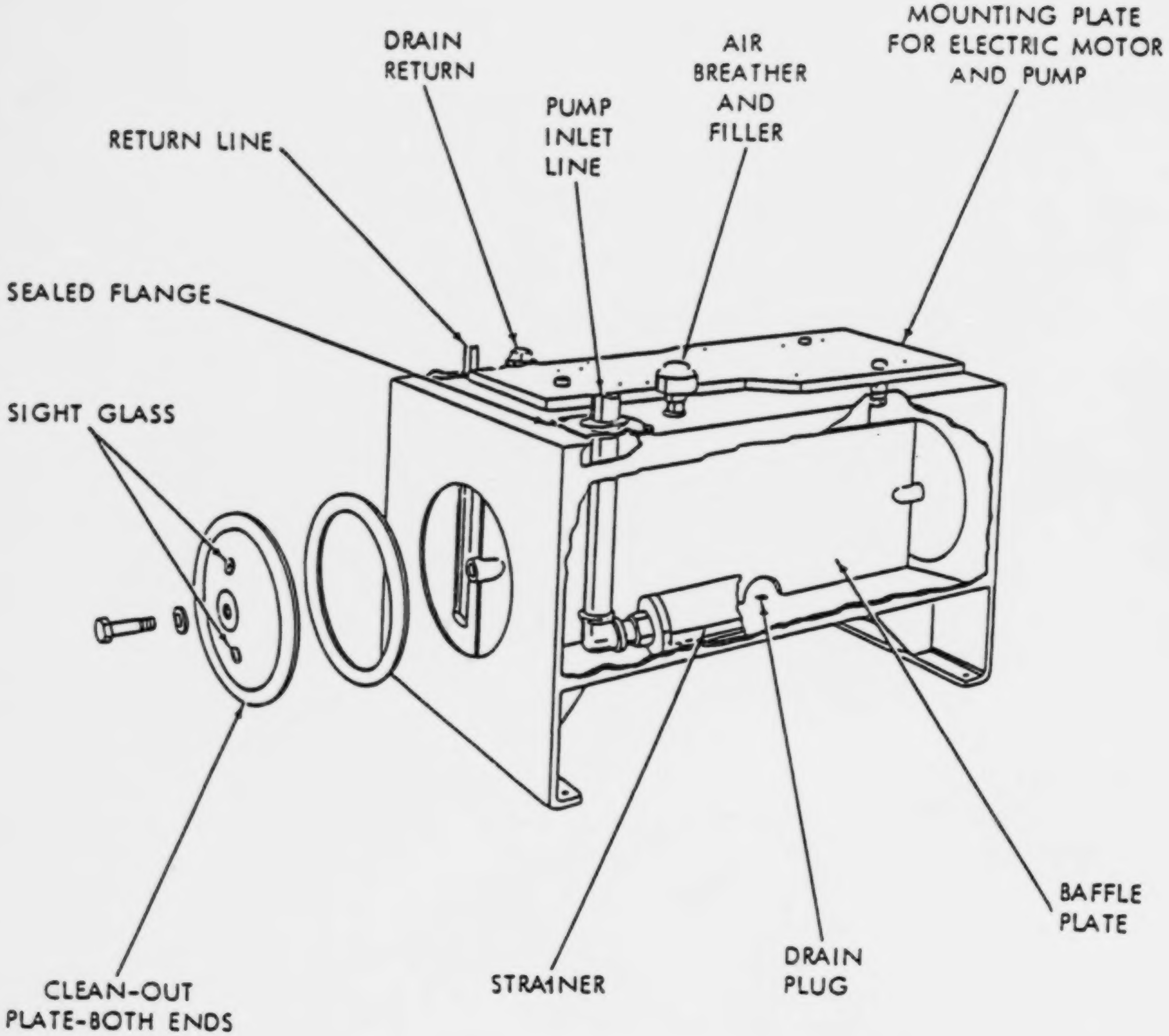
Worksheet A2

TRANSPARENCY



Worksheet A2a

TRANSPARENCY OVERLAY


MOUNTING PLATE FOR ELECTRIC MOTOR AND PUMP
DRAIN RETURN
AIR BREATHER AND FILLER
PUMP INLET LINE
RETURN LINE
SEALED FLANGE
SIGHT GLASS
BAFFLE PLATE
DRAIN PLUG
STRAINER
CLEAN-OUT PLATE-BOTH ENDS

Worksheet A3

Analogous colors

Asymmetry

Balance

Compass

Crosshatching

Hue

Isometric drawing

Oblique drawing

Pattern

Proportion

Rhythm

Scale

Schematic diagram

Sections

Symmetry

Tangent

Texture

Tracing

Triad

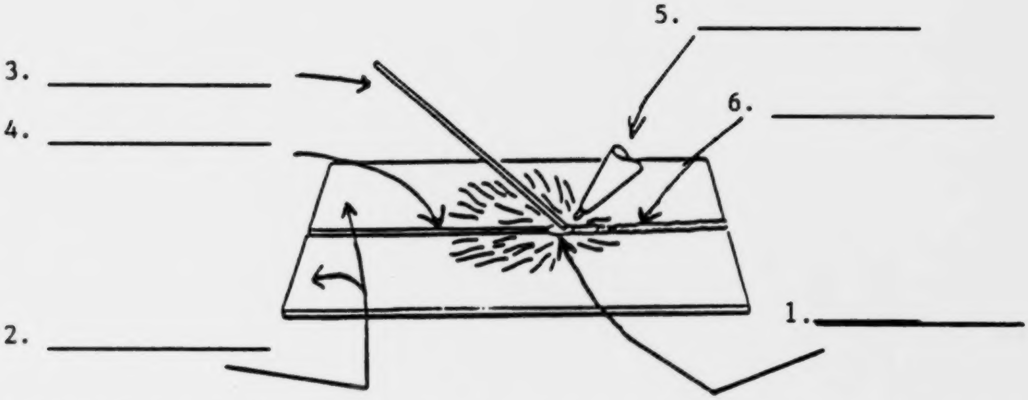
Unity

Worksheet A6

I. Unscramble each of the following words. Write them to the right of each item.

- A. PHA NI SMAE
- B. GEDLNIW ORD
- C. EASB TMALE
- D. DPLDEU
- E. BADE
- F. RTCOH IPT

II. Label each part correctly.



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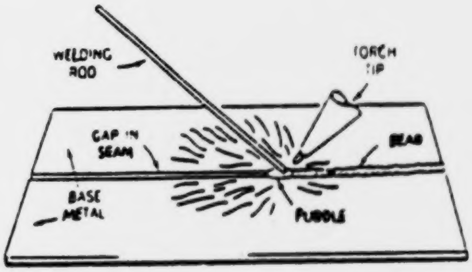
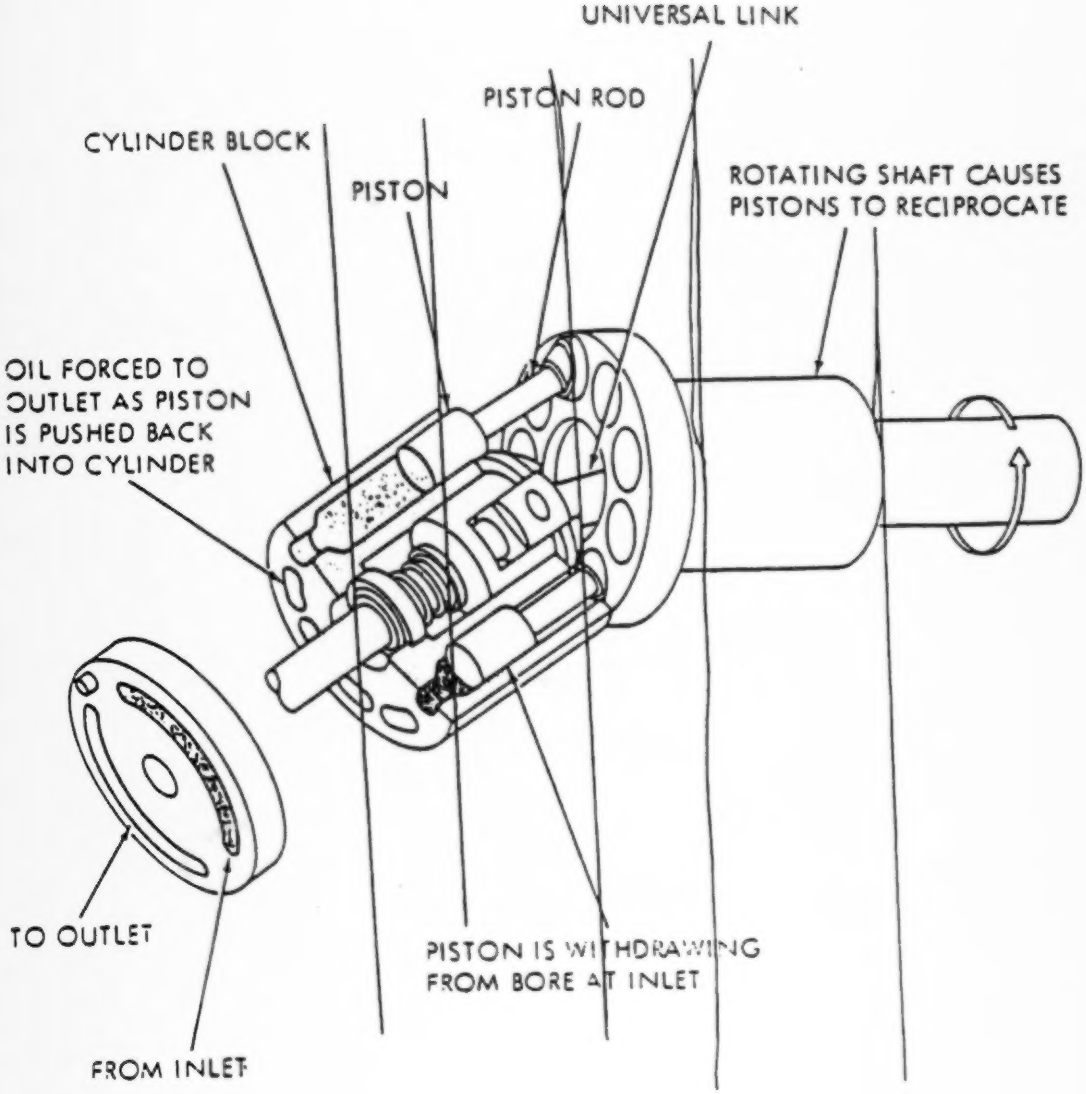
Worksheet A6a Answer Sheet


WELDING ROD
TORCH TIP
GAP IN SEAM
BEAD
BASE METAL
PUDDLE

Worksheet A7


UNIVERSAL LINK
PISTON ROD
CYLINDER BLOCK
PISTON
ROTATING SHAFT CAUSES PISTONS TO RECIPROCATE
OIL FORCED TO OUTLET AS PISTON IS PUSHED BACK INTO CYLINDER
TO OUTLET
FROM INLET
PISTON IS WITHDRAWING FROM BORE AT INLET

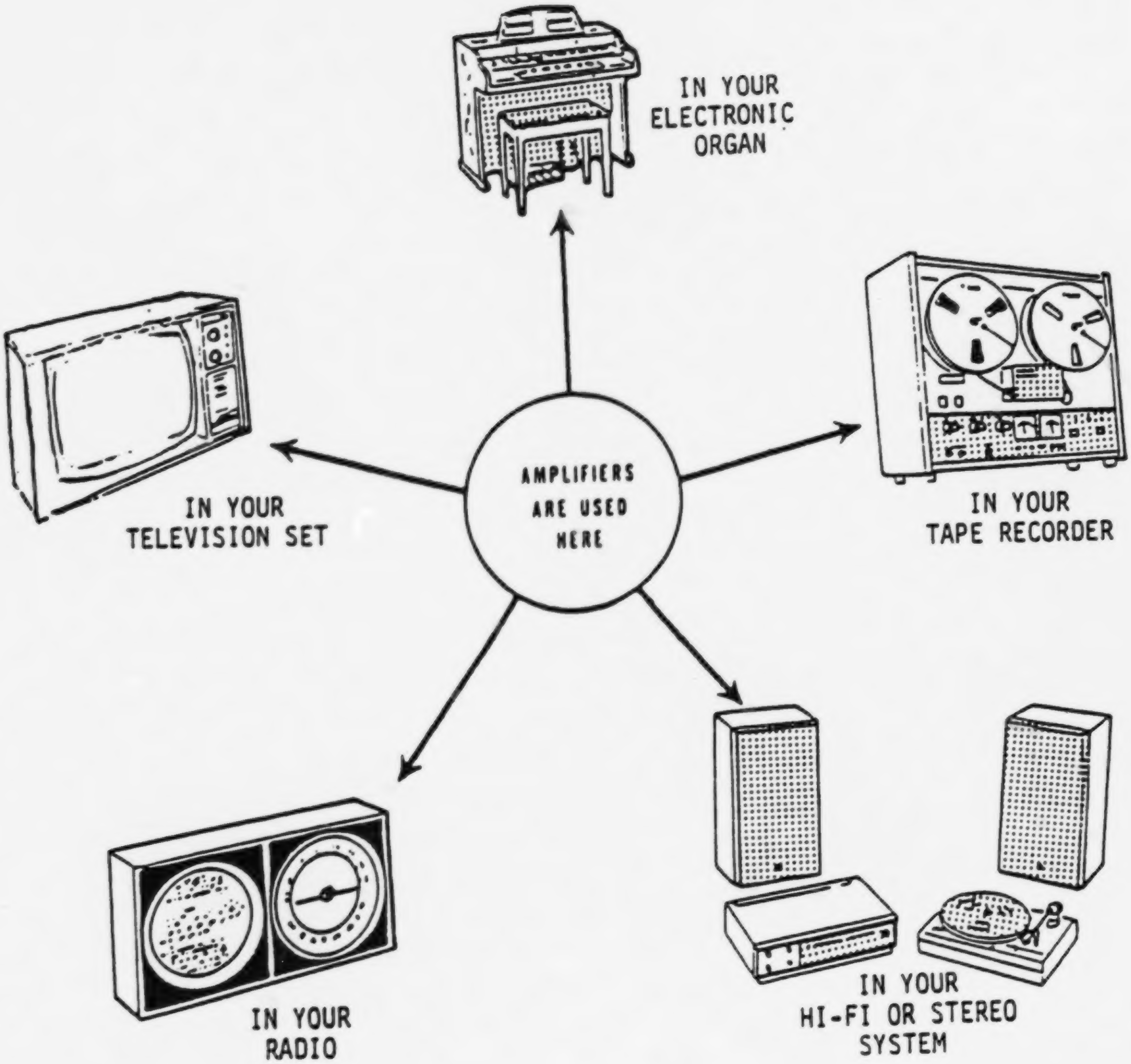
Worksheet A7a

Ask each student to identify each of the following parts by pointing to the specific part on completed puzzle.

1. Cylinder block
2. Piston
3. Piston rod
4. Universal link
5. To outlet
6. From outlet

Worksheet B1

ELECTRONIC CIRCUITS


IN YOUR ELECTRONIC ORGAN
IN YOUR TELEVISION SET
AMPLIFIERS ARE USED HERE
IN YOUR TAPE RECORDER
IN YOUR RADIO
IN YOUR HI-FI OR STEREO SYSTEM

Worksheet Bla

As I show you a picture, I want you to explain how amplifiers are used in the items. (Show pictures)

1. television
2. electronic organ
3. tape recorder
4. stereo system
5. radio
6. two-way radio communication systems
7. radar sets
8. electronic security systems
9. public address or intercom systems
10. telephone

Worksheet B3

This review is prepared in a programmed instruction format. It will enhance your understanding of the material presented in this section. Read each of the numbered frames carefully and fill in the missing blanks at the bottom of each frame. The correct answer appears in parentheses at the beginning of the next frame. Use a sheet of paper to cover all of the frames below the one you are reading.

1. An amplifier is a device that increases the ________ of an electronic signal.

2. (level, magnitude, or amplitude) Most amplifier circuits are designed to faithfully reproduce the shape of a signal and therefore do not intentionally introduce ________ into the signal.

3. (distortion) Most modern amplifiers contain a solid-state component such as a ________ which is capable of providing the necessary amplification.

4. (transistor) In addition to the solid-state component, various resistors, capacitors, and inductors are used to control the operation of the solid-state device and effectively regulate the overall characteristics and stability of the ________ circuit.

5. (amplifier) Basically, all amplifiers can be arranged into two groups according to their use. One type is used to amplify signal voltages and it is therefore referred to as a ________ amplifier.

6. (voltage) The second type is used to amplify the power level of a signal and is therefore referred to as a ________ amplifier.

7. (power) A power amplifier provides power amplification by raising the input signal current to a higher level. This is why a power amplifier is sometimes referred to as a ________ amplifier.

8. (current) Amplifiers may be classified according to their circuit configuration. When a transistor is used in the amplifier, the three possible circuit configurations are the common-______________, common-______________, and common-______________ circuits.

Worksheet B3 Continued

9. (emitter, base, collector) Amplifiers may also be grouped according to their class of operation. The four commonly used classes of operation are class ______________, class ______________, class ______________, and class ______________.

10. (A, B, AB, and C) Another way of classifying amplifiers is by frequency. The operating frequency may extend from zero, in the case of a DC signal, to extremely high frequencies. Five typical examples include ____________ amplifiers, ____________ amplifiers, __________ amplifiers, ____________ amplifiers, and ___________ amplifiers.

11. (DC, audio, video, RF, and IF) Amplifiers are among the most widely used electronic circuits and are found in some of the instruments that are commonly used in the home. Five instruments in the home which use amplifiers are ____________, ____________, ____________, ____________, and ____________.

(radios, television sets, stereo or hi-fi sets, tape recorders, and electronic organs).

Worksheet B6

As wide reading in the content areas expands, the importance of developing recognition of more technical words increases. Content areas include vocabulary words of a technical nature that are not frequently included in other areas of recreational reading.

Time Needed: The following activity requires a total of approximately one hour and 20 minutes.

30 minutes to skim and note vocabulary words
30 minutes for introduction
15 minutes for the game
5 minutes to record and evaluate

Materials:
Tagboard
Felt-tipped marker
Scissors
Index cards, 3" x 5"
Master list of vocabulary definitions
Die
Paper and pencils

Preparation: Select a given unit of study you will soon be using. Ask students to skim some reading material from that unit of study and jot down unknown words of a technical nature that occur in the reading.

Activity Directions:

Have each student choose any ten words that he or she will concentrate on learning. Additional words can be added when appropriate. Each student writes his or her own words on 3" x 5" cards. Then make up a master answer sheet that has all of the words in alphabetical order with an accompanying sentence that defines each word according to the contest of the unit of study.

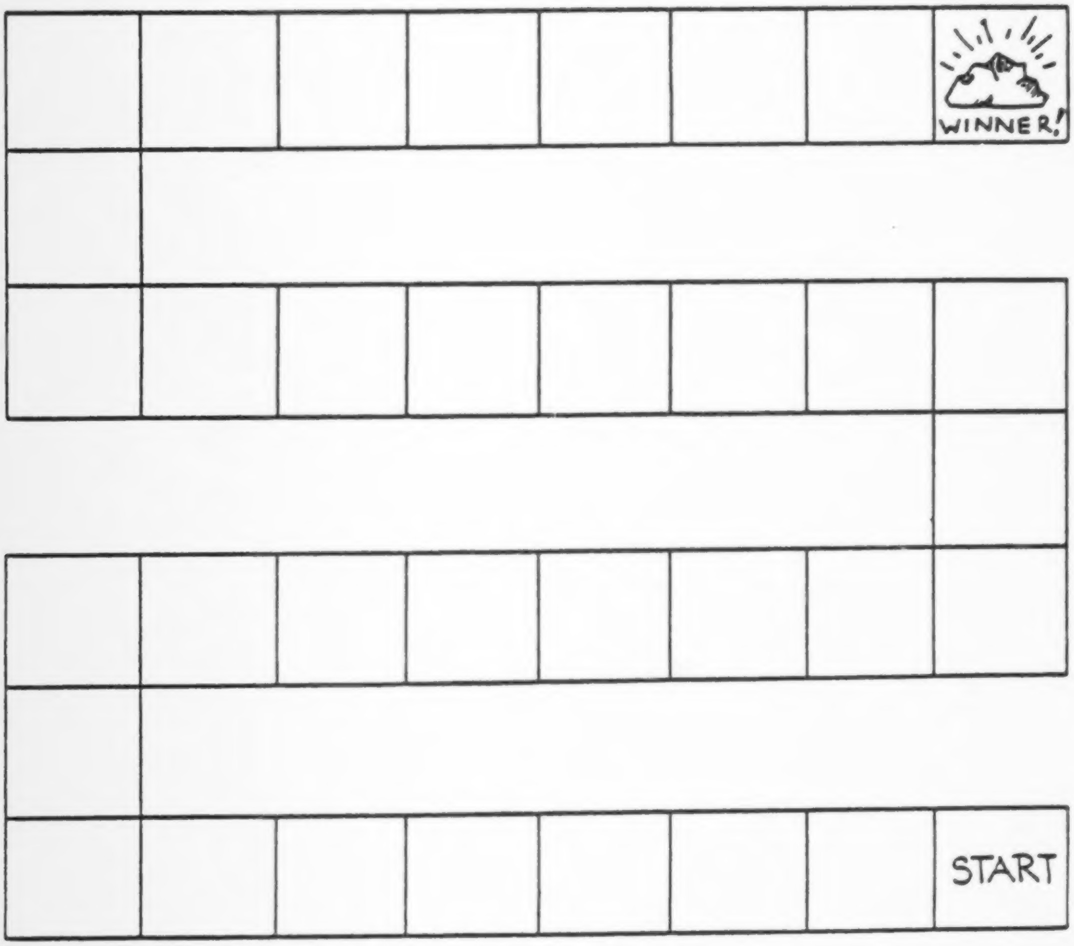
Have the students design a gameboard and title it according to the topic being studied. For example, in studying electronics words, the board might be titled "Buzz Words."

The students should also write their names on the back of each of their word cards. Gameboard markers can be made from the tagboard in the shape of resistors, diodes, etc.

Each player then takes three face-down cards from his or her own vocabulary cards. Alternately, each player turns over one card, says the word, and gives a definition according to the unit of study. The player to the right or a person designated as a "checker" makes sure that the definition is accurate. If the definition is acceptable, the player rolls the die to see how many places to advance forward on the gameboard.

The winner is the player who reaches the golden nugget first or the player who is closest to it at the end of a specified period of time.

Worksheet B6 Continued


WINNER!
START

Worksheet B6 Continued

Culmination of Activity:

Each student uses his or her own list of vocabulary words as a record sheet. A check mark is placed beside each word that was correctly defined in the game. Words that were incorrectly defined are noted at the bottom so that they may receive special attention.

George Todd

Electronic Words

	April 7	April 24	May 4
1. Resistor	✓	✓	✓
2. Transistor			✓
3. Diode		✓	✓
4. Circuit	✓	✓	✓
5.			
6.			
7.			
8.			
9.			
10. Circuit Board	✓	✓	
To be learned:			

Evaluation:

After initial experience with the words during the vocabulary game, students who have scores of 70 percent or higher are successful in this activity. New words may be added when the original ones are mastered with 90 percent or higher accuracy.

Supplementary Activity:

A basic core group of technical vocabulary words for a unit may be selected and used as the common words for all students who use the game.

INSTRUCTIONAL MODULE

ACCESS SKILL: STUDENT WILL BE ABLE TO IDENTIFY AND USE COMMON HAND TOOLS SAFELY

TASK ANALYSIS STEPS: A - H

VOCATIONAL AREA:
Auto Body
Auto Mechanics
Carpentry
Diesel Mechanics
Heating and Air Conditioning
Welding

ACTIVITY		MATERIALS/RESOURCES
TASK A:	Student will identify and correctly name common hand tools	
1.	Give student pretests to find what tools are known to the student.	Pretest A and B
2.	Obtain various hand tools. Tape the names of the tools on them. Have the students practice naming the tools. After the students can identify the tools with names on them, remove the names and have students again practice naming the tools.	Screwdriver, hammer, pliers, saw, wrench, file, chisel, etc.
3.	Give the students pictures of tools, or develop worksheets from a wood shop textbook. Review the various tools with the students.	Worksheets A2a-A2d; Cabinet Making and Millwork
4.	Have the students develop a card file of common hand tools. Using catalogs, magazines and/or store advertisements, have the students find pictures of common hand tools. Have the students place the pictures on 3 x 5 cards. Then write the name of the tool and how it's used on the back. Divide the students into groups of two. Have them ask each other to identify each tool.	Worksheet A3 catalogs, magazines, store advertisements, scissors, glue, 3 x 5 cards
5.	Give each student a picture of several hand tools. Have them match the tool with its name.	
6.	Give students a worksheet with all of the tools names. Label the tools A-T and display them on a table. Ask the students to put the correct letter that appears on each tool next to its proper name on the worksheet. Be sure to go over the names with each student individually (if possible) to be sure the students recognize and understand how to read each. (See Worksheet C1.)	Worksheet A5, pencils, tools, and labels for each tool
TASK B:	Student will identify safety rules to follow in handling hand tools	
1.	Discuss with the students that the next step to using the tools is to learn the safe handling of each tool. Demonstrate the safety techniques involved in the use of each and allow the students to demonstrate to each other in pairs. Remind the students to keep the noise down so you can listen for anyone who needs help (this will also possible prevent the children from getting careless when handling the tools).	Tools
2.	Divide the students into two groups. Have one group list safety rules to follow in using a screwdriver, hammer, and pliers. Have the other group list safety rules to follow in using a saw, wrench, file and chisel.	Worksheet B2
3.	Have the industrial arts teacher demonstrate proper maintenance procedures in caring for hand tools. Have the students practice these procedures under the supervision of the industrial arts teacher.	Industrial Arts teacher

ACTIVITY	MATERIALS/RESOURCES
TASK B: CONTINUED	
4. Have each student role play an industrial arts teacher explaining safety rules to follow in using a specific hand tool and the proper maintenance procedures. Have each student select a different hand tool.	Common hand tools
5. Have the children write the names of each tool on large cards and as you hold up the name, ask them to tell you the things they need to remember when handling that tool safely and why.	Large cards, pens
6. Split the students into pairs or very small groups and watch them demonstrate the correct use of each of the tools listed. Be sure each student does it exactly right without assistance before going on to another tool. You may want to use a check-off list to check off which students can correctly use which tools.	Tools, checkoff list, pencil
7. Have the students design a safety poster that shows the correct way to use a hand tool.	
TASK C: Student will select the correct hand tool for a specific task	
1. Have the industrial arts teacher show the correct hand tool used for specific tasks. Have the industrial arts teacher name specific tasks and have students identify the correct hand tool to be used.	Industrial Arts teacher
2. Give the students a specific function of a hand tool and have them identify the correct tool.	Worksheet C2
3. Divide the students into groups of two. Have one student role play the teacher. He names a tool and the other student lists tasks the tool can be used for. After an appropriate length of time have the students exchange places.	
4. Introduce the students to the various pieces of hardware such as nuts, bolts, and screws and the correct tool for the job to be performed.	Nuts, bolts, screws, nails, hand tools
5. Prepare a list of various tasks. Have students identify the correct hand tool and the hardware to complete the task.	Worksheet C5
6. Show the student a picture of an object (tool) and have him/her match its use as written on a worksheet.	Worksheet C6
7. Lead the students in a discussion as to how everybody is different even though we are all people. "When I say the word 'house' you all think of a house, but each house that you picture is probably different. It is the same with tools. If I say the word 'tools' you all think of different ones. Even things like screwdrivers we know are different even though they are screwdrivers. We are going to talk about how each of these tools are different - in looks, material they are made of, weight, length, uses, etc. Who can tell me the difference in a standard screwdriver and a Phillips screwdriver?" (Allow the students to discuss the differences in a few tools and then follow up with Worksheet F1.)	Worksheet C7

ACTIVITY	MATERIALS/RESOURCES
TASK D: Student will be able to set or adjust the tool for proper use and determine correct sizes of fasteners or hardware	
1. Have the industrial arts teacher demonstrate methods of adjusting tools such as the open-end adjustable wrench, vise-grip pliers, socket set, pneumatic wrenches, drills, etc. Then have the students practice adjusting the tools.	Industrial Arts teacher, hand tools
2. Acquire various sizes of nuts and bolts. Have students assemble them.	Nuts and bolts
3. Have various sizes of holes drilled in several boards. Have the students assemble nuts and bolts in the holes.	Boards with holes, nuts and bolts
4. Assemble various sizes of combination wrenches. Give the student a specific size and have him locate it in his set of wrenches.	Combination wrenches
5. Using the nuts and bolts attached to the board in Activity 3, have students find the correct combination wrench that fits the bolt.	Board from Activity 3, combination wrenches
6. Assemble various sizes of sockets and socket wrenches. Have students fit the socket wrench on the sockets.	
TASK E: Student will correctly use common hand tools	
1. Give each student two boards with several holes drilled in them (or use the board from Task D, Activity 3). Also give each student various sizes of nuts and bolts and a screwdriver. Have the students bolt the two boards together. Have the students evaluate each others work.	Board with holes, nuts, bolts, screwdriver
2. Give each student a hammer, two 3-foot long 2" x 4" boards, and an assortment of nails. Have the students nail the boards together in the middle and at each end. Variation of this activity would be to give the students a specific length and have them drive a nail. Give each student a copy of the directions.	Worksheet E3 hammers, nails, 3-foot long 2" x 4" boards
3. Give each student a board with protruding nails. Have the students remove the nails.	Boards with nails protruding, hammer
4. Give each student a 2' by 4' board with holes, screws, and a screwdriver. Have the students screw the screws into the board. Have the students evaluate each others work. After the screws are in the board have the students remove them. Use both standard screwdrivers and Phillips screwdrivers.	2' x 4' boards with holes, screws, screwdrivers
5. Give each student a board with a set of nuts protruding from it and a set of combination wrenches. Instruct the students to tighten the nuts.	Boards with nuts protruding, combination, wrenches
6. Give each student a 3-foot long board. Instruct the students to saw a 1-foot long piece off the board. Have the students evaluate each others work for straightness of cut and neatness in work.	3-foot long boards, saws, rulers
7. Give each student a set of pliers, and short lengths of various sizes of wire and lumber scraps. Have the students practice holding these with the pliers.	Pliers, wire, lumber scraps

ACTIVITY	MATERIALS/RESOURCES
TASK F: Student will return tools to their proper location after use	
1. Discuss with the students the purpose of replacing the tools in their proper location after each use. (In order to make it easy for the next person to locate that tool, to keep the shop neat, etc.)	
2. Using a pegboard, assign a small group of students to place the tools in a specific location on the pegboard. The other group could make tags for each tool to identify the tool, and another group might make tags for the location, so when a tool is removed the person using it will know where to replace it.	Pegboard, tools, small tags with string, small sticky tags, pens, pencils
3. Remove all of the tools from the board once it is completely set up and labeled. Ask the students to replace each of the tools - one tool per student. Then later on ask each student to replace all of the tools without assistance. Whenever working after this, the student should be expected to return the tools to their proper location or possible lose the opportunity to use the tools for a day or so.	Tools, pegboard
Follow-up: Let the parents know what the students have been doing in the class and ask for their cooperation by having the children make a similar pegboard display of the tools they have at their house and label each space and each tool. Ask the parents to make sure the student is actually returning the tool to its proper location each time.	Pegboard, tags, pens, Note to parents
TASK G: Student will demonstrate use of each of the tools studied with no assistance	
1. If at all possible, ask the industrial arts instructor in your school or an interested parent to help out on this day. Ask each student to demonstrate briefly the correct use (including safety and returning the item to its proper place) of each tool we have studied.	
2. As a class, decide on 3 or 4 small projects they would like to build using the tools we have studied (birdhouse, doll-house, a wheelbarrow, etc.) Gather the materials needed to construct each project from parents or possibly the P.T.A. and allow the students enough time to complete the projects.	Wood and various materials as determined by the projects selected
Follow-up: Invite all of the parents in for an opportunity to see all of the projects the students have made. Assign the students each a tool to demonstrate - to tell its use, safety reminders, differences in that tool and another similar tool, etc.	Invitations for parents, completed projects, tools
TASK H: Student will identify the tools needed to build small objects or repair parts without assistance	
1. Discuss with the students the need to know which tools to gather when deciding to build or repair objects.	
2. Have the students think of things they would like to build or repair and see how many tools they can accurately select in order to repair that object.	

ACTIVITY	MATERIALS/RESOURCES
TASK H: CONTINUED	
3. Tell the students you want to build certain objects, and ask them to gather the tools necessary to do so. Then show them pictures of that completed object and check to see how many of the correct tools they would choose. Discuss any errors explaining why you would or would not choose a particular tool. For instance, you would not need a screwdriver to build a birdhouse which is put together with nails and no screws.	Pictures of small items to build (puppet theatre, birdhouse, tool box, etc.)

PRETEST A

Tell the student:

I am going to show you some tools and I want you to name them. You will be allowed 10 seconds to answer correctly and your first answer will be the answer I will accept. Are you ready?

Then either show the student the tools (if you have access to the following tools), or show them the pictures of tools. You may want to make copies of the following pictures and either cut them out and laminate them onto small index cards for identification use, or to be used in any of the other portions of the module. Do not give the student any hints as to what the tool is. Do not tell him/her what the tool does (that is in the second half of the Pretest). Show only one tool at a time (cover the others with a piece of cardboard or cut on the dotted lines between the pictures, so the tools will not be visible after the student has named them). Time the student as in the directions you gave him/her. The student should answer the following:

_____A. hack saw ("saw" is acceptable)
_____B. utility knife ("knife" is acceptable)
_____C. hammer (curved claw)
_____D. pencil
_____E. pliers
_____F. wrench
_____G. standard screwdriver ("screwdriver" is acceptable)
_____H. Phillips screwdriver (must say "Phillips screwdriver)
_____I. socket wrench (must say "socket wrench")
_____J. long nose pliers (must say "long nose pliers")
_____K. scissors
_____L. calculator
_____M. safety glasses ("glasses" is acceptable)
_____N. trowels
_____O. hoe
_____P. file
_____Q. rake
_____R. shovel
_____S. diagonal cutter
_____T. tape measure

____________ Total correct out of 20

Once the student has answered this portion of the test, go on to the second portion asking the student how to use each of the tools.

PRETEST B

Say to the student:

I am going to name some tools and you must tell me their most common use. I will accept you first answer only and you have 20 seconds to answer each one.

"Tell me, what is the most common use for a:

A. Saw: ______________________________(Student response)

Response should be: It is used to cut things like wood, metal, etc. Students must give any of these examples for it to be correct.

B. Hammer: ___________________________(Student response)

Response should be: Used for driving and pulling nails.

C. Pliers: ___________________________(Student response)

Response should be: Used to grip small pieces of wire, wood or metal.

D. Standard Screwdriver: ________________(Student response)

Response should be: Used to install and remove slotted screws.

E. Socket Wrench: _____________________(Student response)

Response should be: Used for holding and turning nuts, bolts, pipes, etc.

F. Scissors: __________________________(Student response)

Response should be: Used for cutting things like paper and materials.

G. Safety glasses: _____________________(Student response)

Response should be: Used for eye protection.

H. Hoe: ______________________________(Student response)

Response should be: Used for cutting up weeds and loosening up the earth in the fields.

I. Rake: _____________________________(Student response)

Response should be: A tool to gather things together - like leaves, scraps, etc.

J. Diagonal cutter: ____________________(Student response)

Response should be: Used to cut wire, and looks like a needle nose pliers without the nose.

K. Utility knife: ______________________________(Student response)

Response should be: Used to cut and trim small pieces of wood and plastics.

L. Pencil: ______________________________(Student response)

Response should be: Used for marking or writing.

M. Wrench: ______________________________(Student response)

Response should be: Used to tighten nuts and bolts, etc.

N. Phillips screwdriver: ______________________(Student response)

Response should be: Used to install and remove cross slotted screws.

O. Long nose pliers: ________________________(Student response)

Response should be: Used to cut wire and hold small objects.

P. Calculator: ___________________________(Student response)

Response should be: Used to compute figures or add, subtract, multiply and divide in order to find the correct answer.

Q. Trowel: ______________________________(Student response)

Response should be: Used for spreading. smoothing or scooping plaster, soil, etc.

R. File: ________________________________(Student response)

Response should be: Used for sharpening metal objects such as a knife or a blade of some sort.

S. Shovel: ______________________________(Student response)

Response should be: Used to lift and move material such as dirt, snow, gravel, etc.

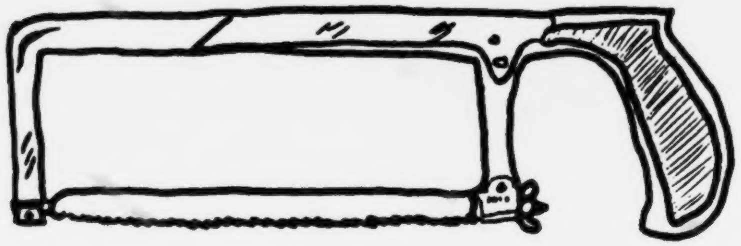
T. Tape measure: __________________________(Student response)

Response should be: Used to find the length of any object usually up to 10 feet.

Total points ___________ out of 20

If at all possible you might want to ask the student to demonstrate the use of each of these tools for you in their proper and most common use. The tools can usually be borrowed from either a workshop or industrial arts instructor within the schools.

PRETEST PICTURES



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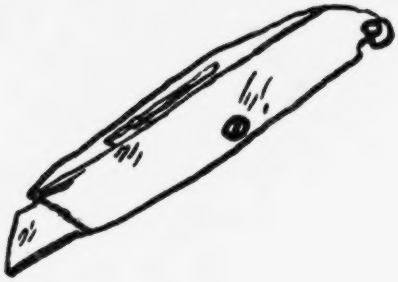

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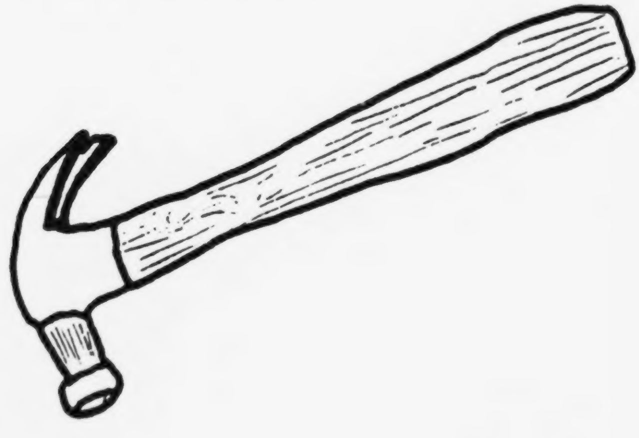

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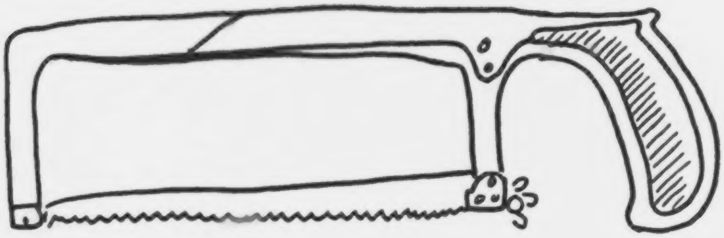
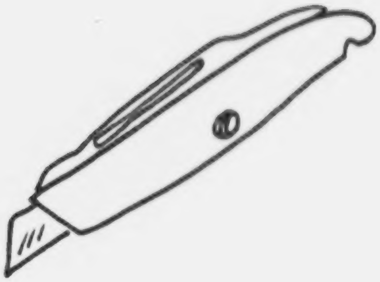
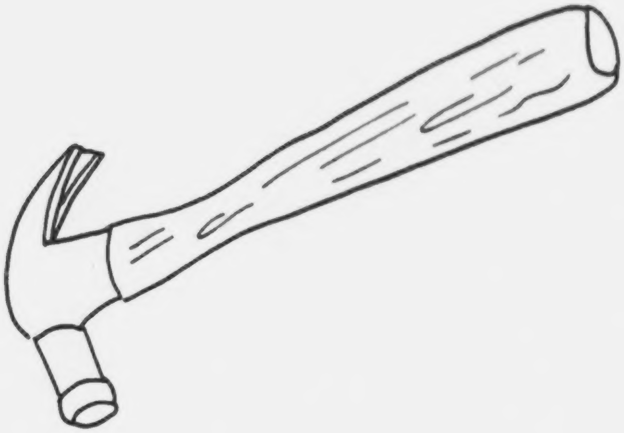
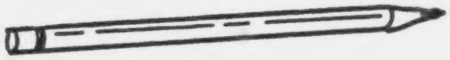
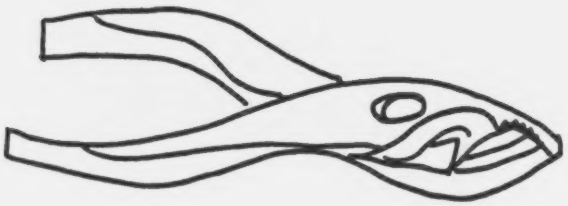
C. ________________________________

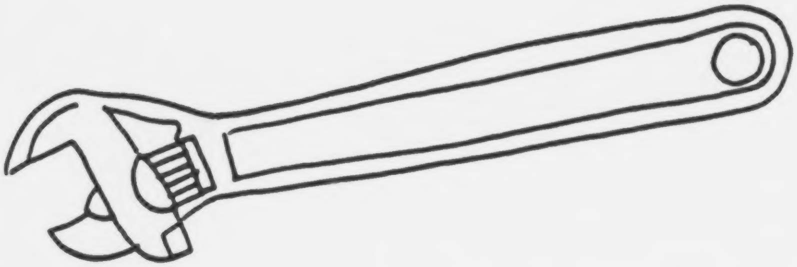


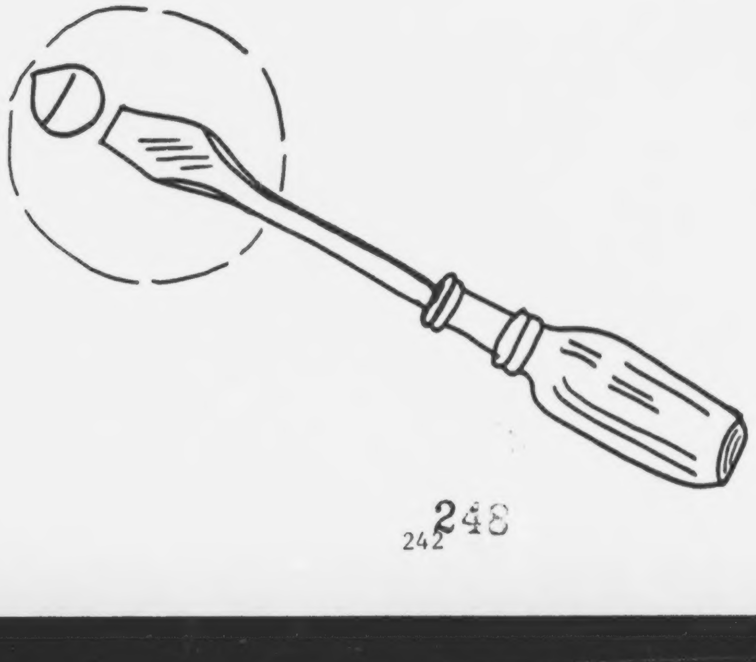


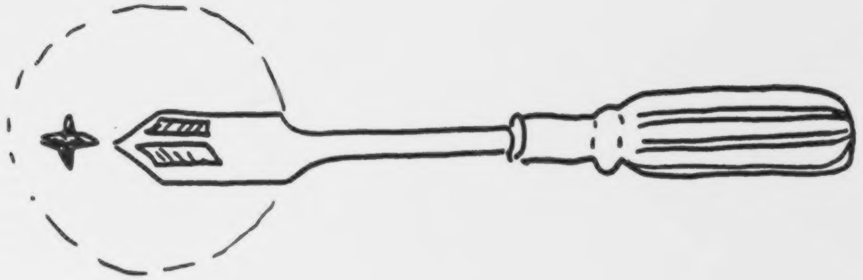


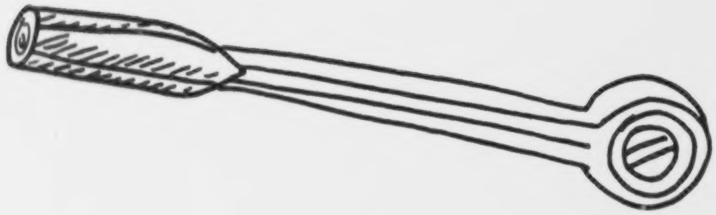


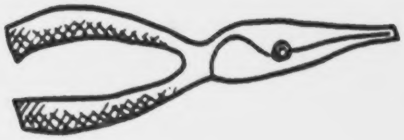


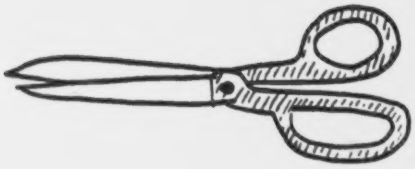


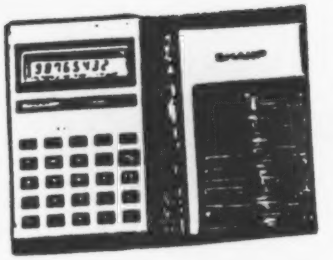








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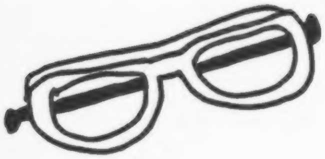
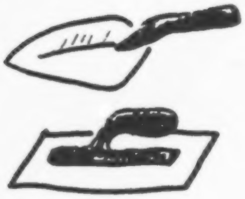
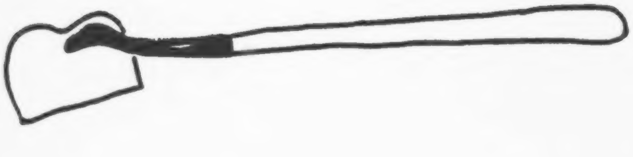
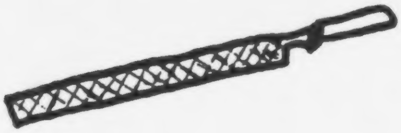


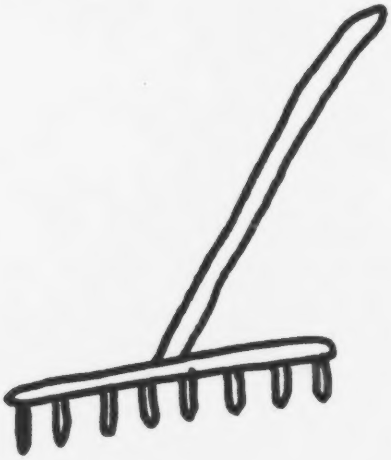




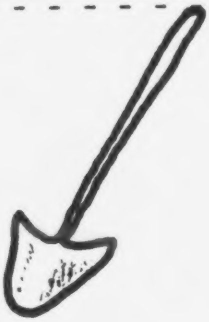
PRETEST PICTURES



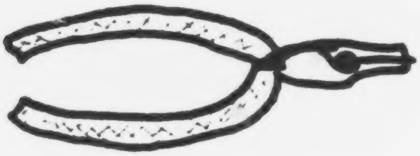
P. ______________________________



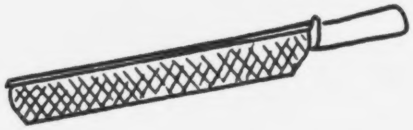
Q. ______________________________

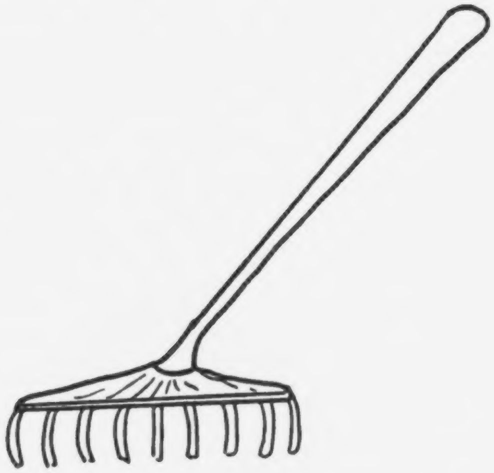


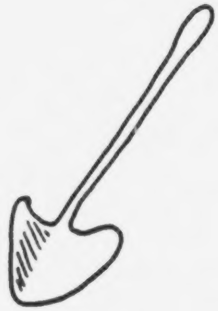
R. ______________________________

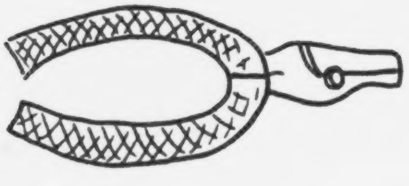


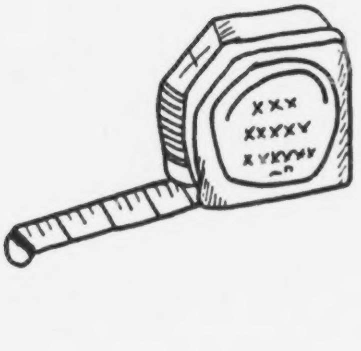
S. ______________________________





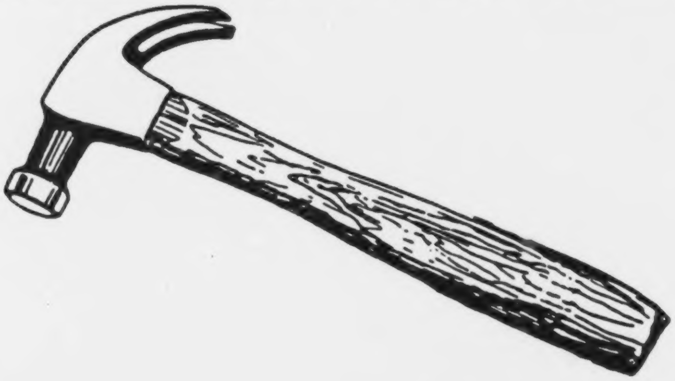




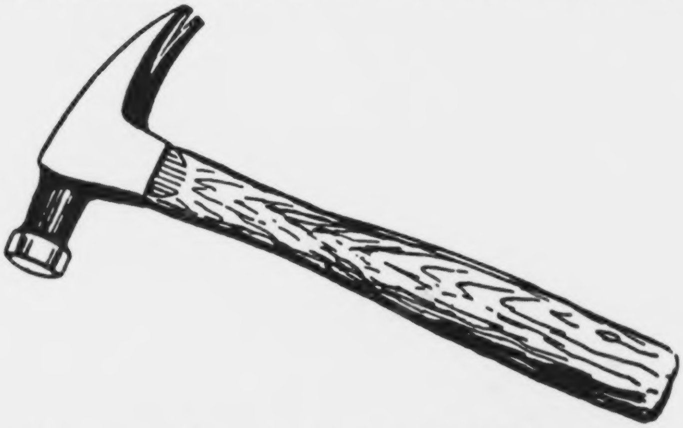


Worksheet A2a

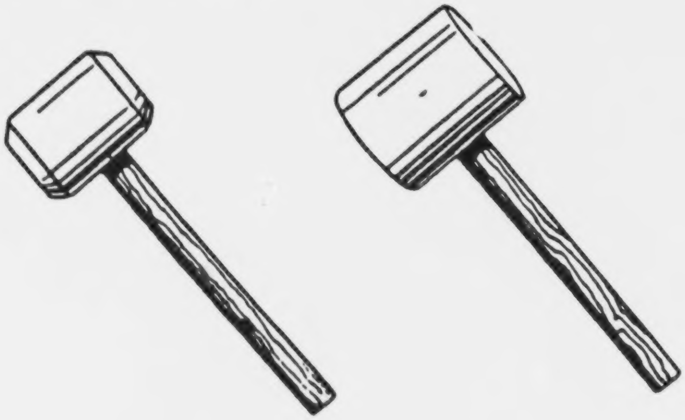
1. **Curved Claw Hammer:** Used for driving and pulling nails.



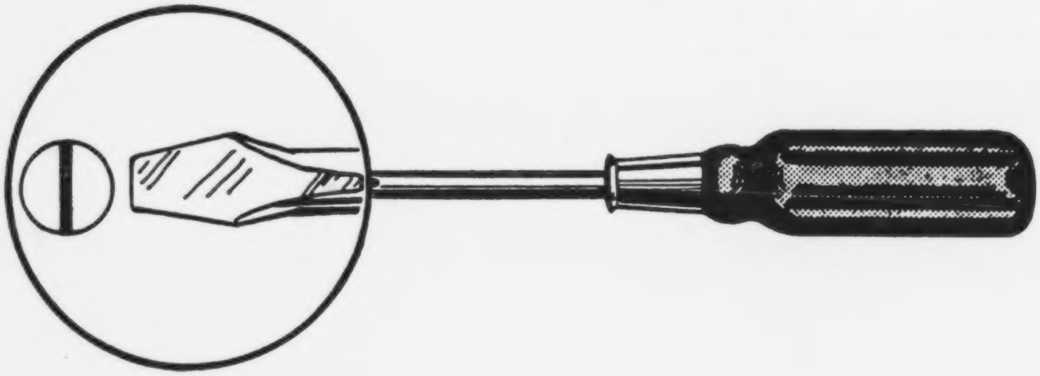
2. **Straight Claw Hammer:** Used for ripping lumber apart.



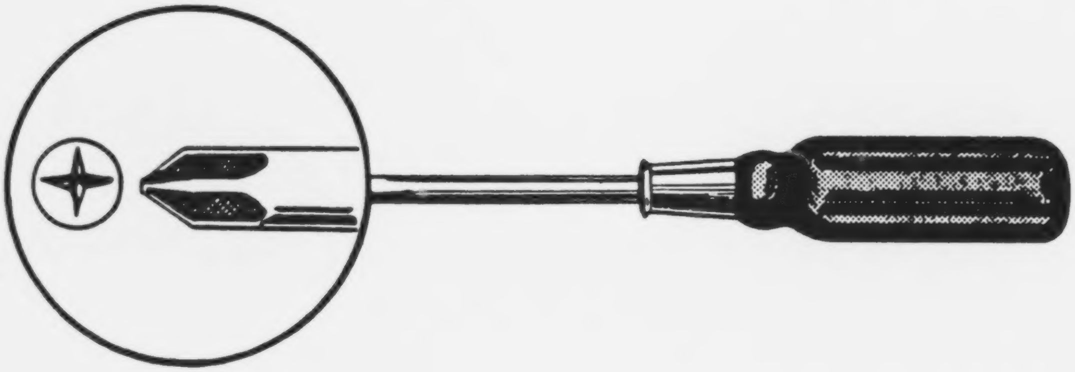
3. **Soft Faced Hammer:** Hammer with rawhide, plastic or wood head used with wood chisels.



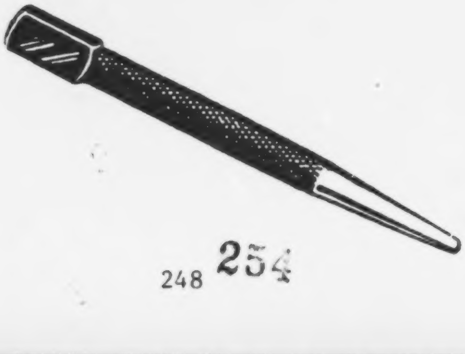
4. **Standard Screwdriver:** Used to install and remove slotted screws.



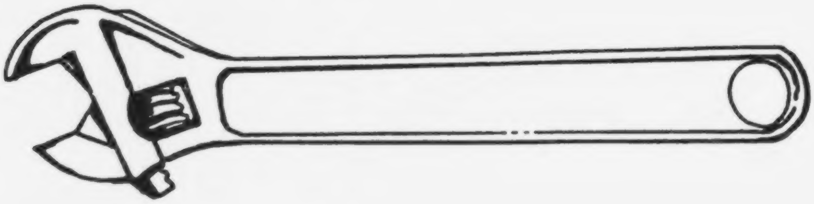
5. **Phillips Screwdriver:** Used to install and remove cross slotted screws.



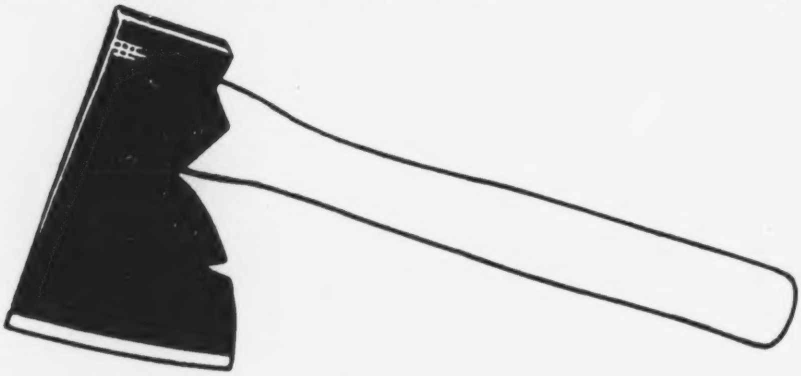
6. **Nail Set:** Used with the hammer to sink nail heads into wood.



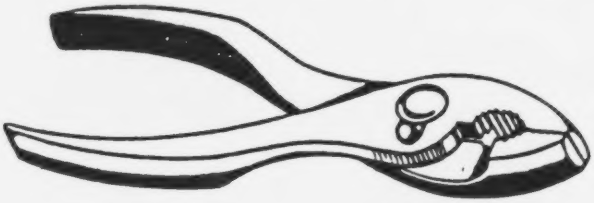
7. **Adjustable Wrench:** Used to remove and install nuts and bolts.



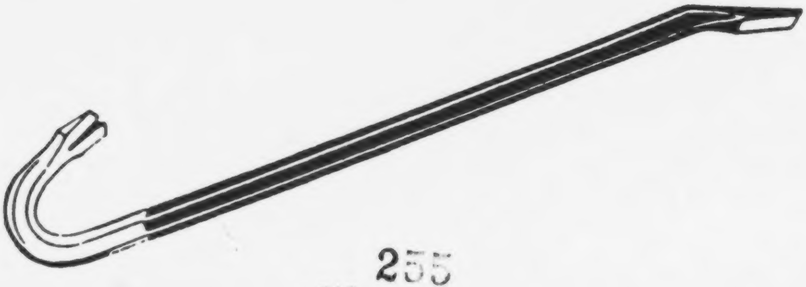
8. **Hatchet:** Used to trim wood pieces and nail flooring.



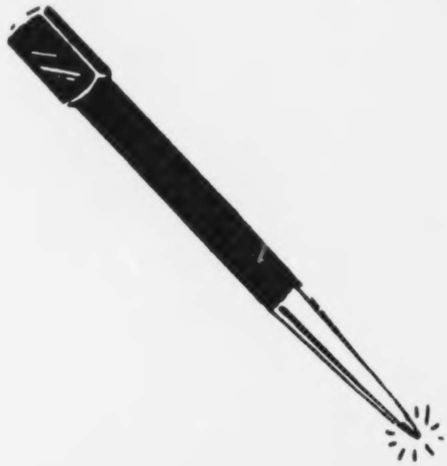
9. **Pliers:** Used to grip small pieces of wire, wood or metal.



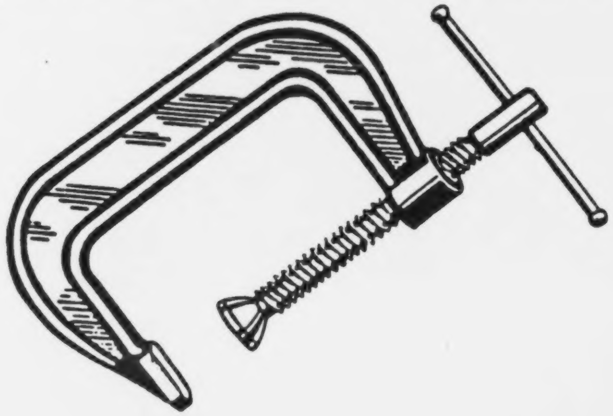
10. **Ripping Bar:** Used to strip concrete forms, pry lumber and pull nails.



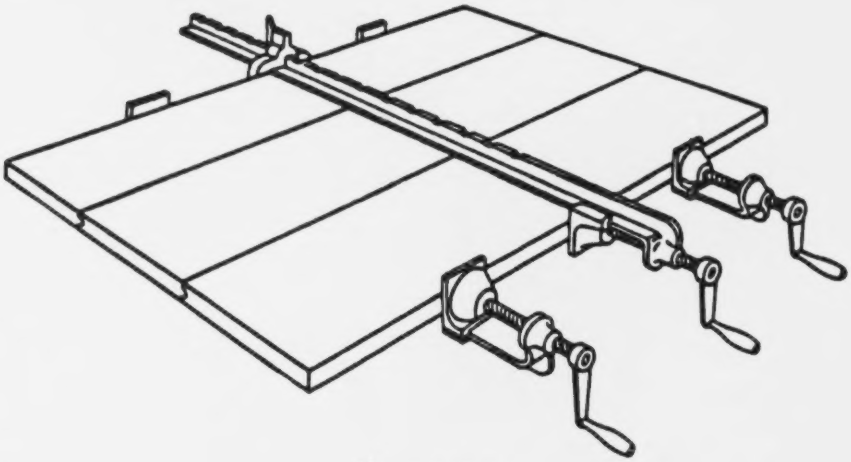
11. **Center Punch:** Used for marking the center of a hole to be drilled.



12. **C-Clamp:** Adjustable device used to hold wood or metal.



13. **Bar Clamp:** Used to assemble products and hold glued edges.



Worksheet A3

COMMON HAND TOOLS

Curved Claw Hammer

Straight Claw Hammer

Soft Faced Hammer or Mallet

Standard Screwdriver

Phillips Screwdriver

Nail Set

Adjustable Wrench

Combination Wrench

Socket Wrench

Hatchet

Combination Pliers

Round-nose Pliers

Ripping Bar

Center Punch

C-Clamp

Bar Clamp

Chisel

File

Saw

Hacksaw

Coping Saw

Worksheet A5

Directions: Find all of the tools on the table in the back of the room. Read over the names of each of the tools on this worksheet. If you do not recognize the name of one of the tools, be sure to ask your teacher before you begin to complete this worksheet.

Walk by the tools on the table and decide what the first tool is and put the letter that appears on that tool next to the name of the tool on this sheet.

For example: If the first item on the table was a hammer, and had an A beside it, I would put an A on the blank line next to the word hammer.

_____ tape measure

_____ diagonal cutter

_____ shovel

_____ rake

_____ file

_____ hack saw

_____ utility knife

_____ hammer

_____ pencil

_____ pliers

_____ wrench

_____ standard screwdriver

_____ socket wrench

_____ long nose pliers

_____ scissors

_____ calculator

_____ safety glasses

_____ trowels

_____ hoe

_____ Phillips screwdriver

Total correct _______

To the teacher:

Display only the items listed above on a table in the back of your classroom and label each tool with the letters A to T. Allow the students approximately 15 minutes to match all of the items with their name and then grade their answers or have the correct name on the back of the label for them to self-check.

Worksheet B2

Safety Rules in Using a Screwdriver

1. Use the correct size screwdriver for the screw being handled.
2. When driving or removing a screw, hold the screwdriver square with the screw and guide the tip with your free hand.
3. A screwdriver is not a substitute for a chisel or to be used as a pry.
4. Do not use a screwdriver in which the tip is worn.

Safety Rules in Using a Hammer

1. Do not use a hammer unless the head is on tightly and the handle is solid.
2. Knuckles can be injured if you "choke up" too far on the handle when striking a blow.
3. Unless the blow is struck squarely, the hammer may glance off the work.

Safety Rules in Using Pliers

1. Do not use pliers as a substitute for a wrench.
2. Use pliers large enough for the job.
3. Clean and oil pliers frequently.
4. Store pliers in clean, dry place.
5. The jaws may become deformed if the tool is used on an object that is larger than the tool's designated capacity.

Safety Rules in Using a Saw

1. Do not test the sharpness of the blade by running your finger across the teeth.
2. Be sure the blade is properly tensioned.
3. Store the saw so you will not accidently reach into the teeth when you pick it up.
4. Apply enough pressure on the forward stroke to make the teeth cut.
5. Be sure to keep the blade cutting in a straight line.

Safety Rules in Using a Wrench

1. The movable jaw should always face the direction of the rotation.
2. Always pull on a wrench. You have more control over the tool if pulling instead of pushing and there is less chance of injury.
3. Select a wrench that fits properly.
4. Never hammer a wrench to loosen a stubborn fastener.

Worksheet B2 Continued

Safety Rules in Using a File

1. Apply just enough pressure to permit the file to cut on the entire forward stroke.
2. The work must be held solidly for effective filing.

Safety Rules in Using a Chisel

1. Hold the chisel in such a manner that if you miss a stroke with the hammer it well not strike your hand.
2. When using a chisel, wear safety goggles.
3. Do not use a chisel in which the chisel head is mushroomed.

Worksheet C2

Read the function of a tool and then name the tool that goes with it.

1. _____ Used to grip small pieces of wire, wood, or metal.
2. _____ Used to hold wood or metal.
3. _____ Used for driving and pulling nails.
4. _____ Used to remove and install nuts and bolts.
5. _____ Used to install and remove slotted screws.
6. _____ Use for ripping lumber apart.
7. _____ Used when a smooth finish is desired.
8. _____ Used for cutting curved shapes.
9. _____ Used to install and remove cross-slotted screws.
10. _____ Used to sink nail heads into wood.

A. Coping Saw
B. Adjustable Wrench
C. Nail Set
D. Standard Screwdriver
E. C-Clamp
F. Straight Claw Hammer
G. Combination Pliers
H. Phillips Screwdriver
I. File
J. Curved Claw Hammer

ANSWER KEY

1. G
2. E
3. J
4. B
5. D
6. F
7. I
8. A
9. H
10. C

Worksheet C5

Read the task. Decide what hand tools and hardware are needed to complete the task.

1. You want to hang a picture on the wall.
2. The teacher needs a bookshelf with two shelves.
3. One side of the blackboard has come loose from the wall.
4. You need to remove the rivets from a metal cabinet.
5. The water pipe is leaking.
6. The wrought iron railing has a rough, sharp spot on it.
7. You need to take the old bookshelves apart.
8. You need to put the wrought iron chair together.
9. You need to reattach the clothesline wire to the post.
10. You need to remove the long nails protruding from the board.

ANSWER KEY

1. hammer, nail
2. saw, hammer, nails, nail set
3. screwdriver, screw
4. chisel
5. wrench
6. file
7. straight claw hammer
8. nuts, bolts, wrench
9. pliers
10. ripping bar

Worksheet C6

Directions: Watch as your teacher shows you pictures of objects one at a time. You are to match that object with the use of the object on the lines below.

Used to mark or write ____________________

Used to tighten nuts, bolts, etc. ____________________

Used to install and remove cross slotted screws ____________________

Used to cut wire and hold small objects ____________________

Used to compute figures or add, subtract, multiply and divide in order to find the correct answer ____________________

Used for spreading, smoothing or scooping plaster, soil, etc. ____________________

Used for sharpening metal objects such as a knife or a blade of some sort ____________________

Used to lift and move material such as dirt, snow, gravel, etc. ____________________

Used to find the length of any object up to 10 feet in length usually ____________________

Used to cut things like wood, metal, etc. ____________________

Used for driving and pulling nails ____________________

Used to grip small pieces of wire, wood or metal ____________________

Used to install and remove slotted screws ____________________

Used for holding and turning nuts, bolts, pipes, etc. ____________________

Used for cutting paper or cloth material ____________________

Used for eye protection ____________________

Used for cutting weeds and loosening up the earth in the fields ____________________

Used to gather things together - like leaves, scraps, etc. ____________________

Used to cut and trim small pieces of wood and plastics ____________________

Used to cut wire, and looks like a needle nose pliers without the nose ____________________

Total correct ____________________

Worksheet C7

Directions: On this page, you will find two tools named in each group. You are to match the letter in front of the tool with the use of the tool in the right hand column. Some tools will be used for more than one of the possibilities.

Example:
a. hammer
b. screwdriver

__b__ You can install with this tool
__a__ You can install a nail with this tool
__a__ You can remove nails with this tool

1. a. hack saw
   b. diagonal cutter

_____ It can cut objects
_____ It can cut through bolts

2. a. hammer
   b. pencil

_____ You can pound things with this tool
_____ You can pound nails into a wall with this tool
_____ You can draw with this tool

3. a. pliers
   b. wrench

_____ You can hold small items with this tool
_____ You can turn nuts and bolts with this tool
_____ You can twist small pieces of wire with this tool

4. a. standard screwdriver
   b. Phillips screwdriver

_____ You can install and remove screws
_____ You can install and remove slotted screws
_____ You can install and remove cross-slotted screws

5. a. socket wrench
   b. long nose pliers

_____ You can hold small objects with this tool
_____ You can cut wire with this object

6. a. scissors
   b. utility knife

_____ You can cut wood and plastics with this tool
_____ You can cut paper with this tool
_____ You can cut this item

7. a. safety glasses
   b. calculator

_____ You wear this item for working safely
_____ You can wear this item

8. a. trowels
   b. hoe

_____ You can smooth plaster with this tool
_____ You can dig in your garden with this tool

Worksheet E3

Follow these directions.

1. Measure over 1 1/2 feet and drive a nail into the board.
2. Measure over 2 feet 7 1/2 inches and drive a nail into the board.
3. Measure over 1 foot 3 3/4 inches and drive a nail into the board.
4. Measure over 8 1/4 inches and drive a nail into the board.
5. Measure over 2 feet 2 3/8 inches and drive a nail into the board.
6. Measure over 1 foot 9 7/8 inches and drive a nail into the board.
7. Measure over 4 5/16 inches and drive a nail into the board.
8. Measure over 2 feet 10 13/16 inches and drive a nail into the board.

INSTRUCTIONAL MODULE

VOCATIONAL AREA:
Auto Body
Auto Mechanics

ACCESS SKILL: IDENTIFY BASIC PARTS OF THE AUTOMOBILE BODY

TASK ANALYSIS STEPS: A-E

ACTIVITY	MATERIALS/RESOURCES
NOTICE FOR MODULE INSTRUCTION TO THE TEACHER, This module consists of the development of a student workbook. Please READ IT ALL THE WAY THROUGH BEFORE BEGINNING. Because of the nature of the activities it is important to build this workbook page by page. It is suggested that you run off enough copies of the pages to keep on hand so they are available as you come to each page. Some of the pages are answers to the worksheets. There are also separate worksheets to accompany the workbook. It is further suggested that prior to this module usage you acquire a large variety of advertising brochures from auto dealers so the student may have colored pictures over the black and white ones in the student text. This can also be done for the three activity games. Car magazines are another good resource. Proper preparation for this module will provide an exciting and rewarding experience for both teacher and student.	
TASK A: Student recognizes differences between automobile bodies	
1. Unit 1 of Student workbook introduces the concept of the Auto Body functioning as a protection from the elements and collision. An awareness of differences between the body styles is achieved through Activity 1 Style Trial and Activity 2 Vehicle Valet.	
Activity 1 Style Trial requires the student to examine two automobiles and note differences between the two.	Activity 1-Style Trial, Worksheet A1, 1a, 1b, 1c
Activity 2 Vehicle Valet requires the student to group automobiles by common characteristics (i.e. 2 doors; 4 doors; convertibles; station wagons).	Activity 2-Vehicle Valet, Worksheets A2, 2a, 2b, 2c, 2e
Follow-up: Discussion might be helpful to emphasize the point that although Auto Body's are similar in design they do have distinguishable features. Students can be lead to identify how cars might differ in body style. Flashcards can be constructed with pictures of various cars to be used for follow-up activities to enable students to recognize differences and group according to common features. 1. Pictures of different body styles can be presented in pairs and student can state how styles differ. 2. Numerous pictures of body styles can be presented with student grouping them by common features.	Teacher constructed flashcards can be made from picures of automobiles available from dealers (advertising) brochures and magazine ads. The teacher should try to get as many different makes and models as possible to enable the student to compare all the automobiles to ensure that the student distinguishes body style not make of automobile. To maximize interest color photographs of the latest models, readily obtainable through local dealers, should be used.

ACTIVITY	MATERIALS/RESOURCES
TASK B: Student explores features differentiating the body style	
Lesson 1 of the student workbook develops the skill of discriminating differences in body styles of automobiles. The activities and follow-up have provided experiences for student to see differences between varying styles and to group similar style automobiles. At this point student should be be ready to develop working definitions from these experiences.	
1. Station Wagon: Station wagons are easy to define because they so greatly differ from the other body styles. Begin with station wagons so students can develop the skills to make the rules.	
Teacher writes the word STATION WAGON on the board. On an overhead projector (or by holding up flashcards) teacher shows examples of several station wagons. Students are instructed to study body style of each looking for similarities.	
Students are to brainstorm rules or definitions for identifying station wagons. (These are listed on the board as given by student)	
Ex: STATION WAGON 1. Boxed back end (roof continues to end) 2. Tailgate 3. No trunk 4. Large glass area in back 5. Four doors	
Teacher guides students into eliminating redundent rules (if any). (No trunk statement can be eliminated because of boxed back end statement.)	
Students are instructed to complete a statement on Worksheet B1. *Explain to students that the numbers on the picture of the station wagon will help them to list the rules below the picture. (Ex: 1 on the picture designates the boxed backend students should list this for number 1 on their statement.)	Worksheet B1 Several magazines with automobile ads which can be cut out, tape, scissors
When students have listed the four rules for identifying station wagons these can be reviewed.	
Students then are given scissors, tape, and several magazines. Students are instructed to look through the magazine ads, cut out pictures of two station wagons, and tape them to worksheet.	
2. Covertible Activity 2 is a repeat of activity 1. Students are now developing rules for identifying convertibles.	Worksheet B2 Flashcards picturing various convertibles
One basic rule will probably best identify convertibles (removable or retractable top).	
Instruct students to complete the statement on Worksheet B2.	
At bottom of B2 students will reinforce their skills in identifying convertibles, by cutting pictures out of magazines as done in Activity 1 for station wagons.	

ACTIVITY	MATERIALS/RESOURCES
TASK B: CONTINUED	
3. Hardtops and Sedans Activity 3 is a repeat procedure for Activities 1 and 2. Lead students into discovering the features which distinguish the two. Guide students into identifying the differences in the rear roof pillar design and the rear door window area.	Worksheet B3
TASK C: Student demonstrates understanding of Body Style Classifications by categorizing automobiles into appropriate areas	
1. A bulletin board can be constructed by students in which they can bring in pictures of automobiles and mount them in the appropriate body style area.	Worksheet C1
2. A survey of automobiles in a parking lot or at an intersection can be made by students in which they record the various body styles of automobiles.	Worksheet C2
TASK D: Student develops awareness of the Auto Body as individual components joining to form the whole	
1. Unit 2 introduces students to the Individual Components of an automobile. Upon completion of this unit a field trip to an auto body shop or auto mechanics shop, can be helpful to the students in reinforcing the concepts explored.	Student worktext Unit 2, Activity 3 Hollywood Hot Rod Also have several snap together models to assist student in activity and concept development
TASK E: Student identifies Individual Panel Components by name and can state function	
1. Worksheet E1 assesses students' ability to identify the parts of the auto body exterior and state the main function of each part. This worksheet could serve both as a pre-test and a post-test. Students upon completion of this unit would be expected to be able to complete this worksheet with 85% accuracy.	Worksheet E1

Worksheet A1

INTRODUCTION

TRANSPORTATION

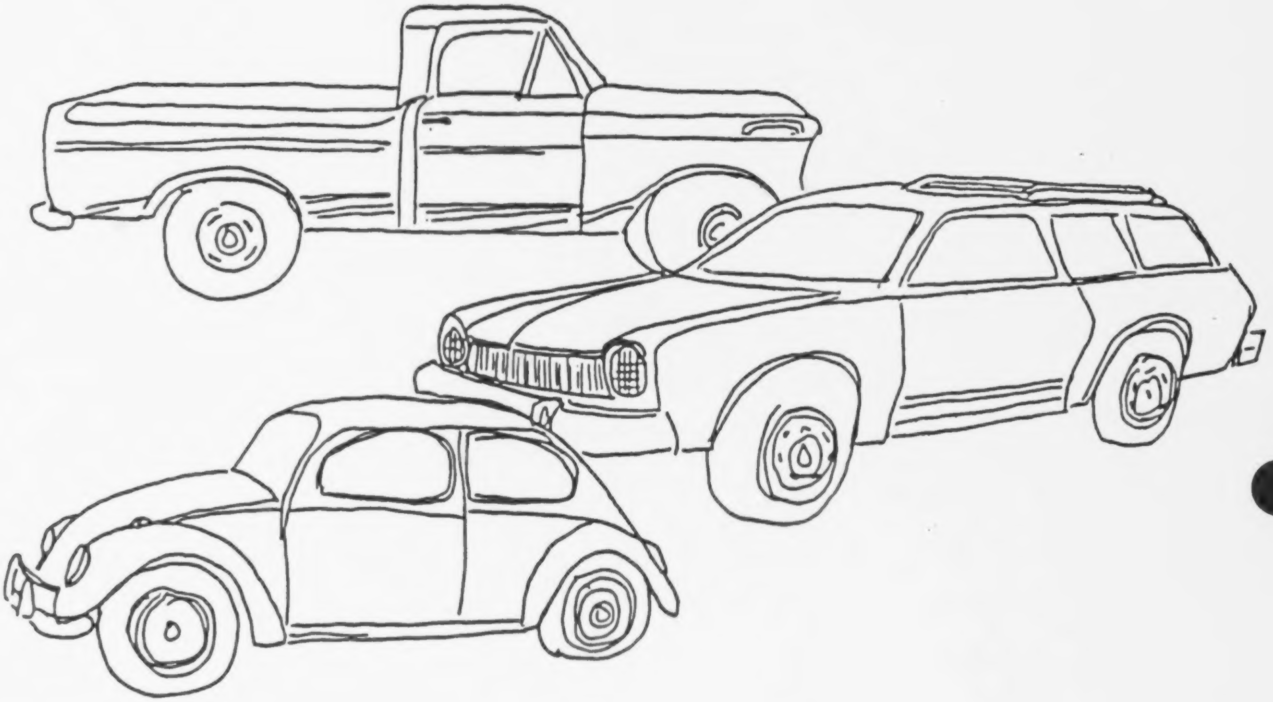
So you want to be an Auto Body Repairperson? It is a job that pays very well. To start an Auto Body Repairperson earns about $6.50 an hour. That's good! But the chances of getting a job are not as good. The need for Auto Body Repairpersons will grow slowly in the future. To get a job you will have to be good. This means you will need good training. A course at the Vo-Tech school will help. You can help yourself by learning something about cars before taking the course. This module will help you by teaching you:

1) To identify the body style of a car.
2) The names of the body parts of a car.
3) What the body parts are for.

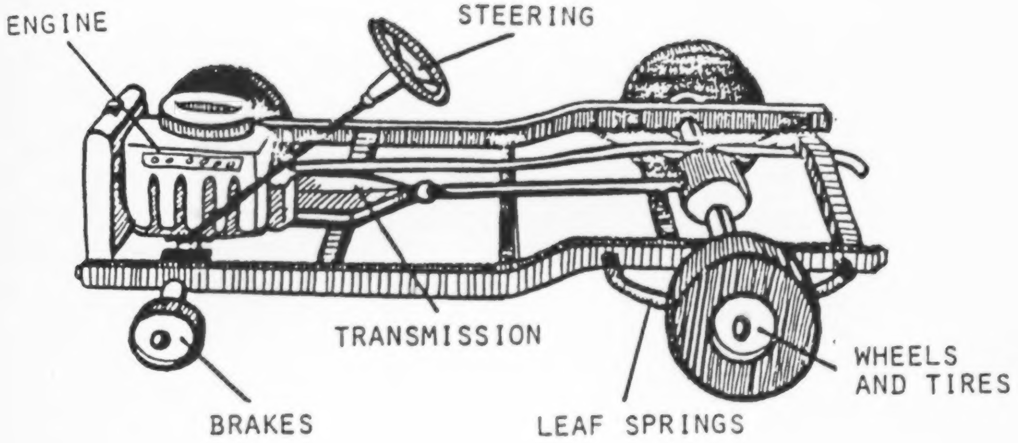
UNIT ONE

BODY LANGUAGE

Cars come in many sizes, shapes, and colors.



What you mainly see if you look at the car is the body. Take off the body and you will see that all cars are pretty much the same.


ENGINE
STEERING
TRANSMISSION
BRAKES
LEAF SPRINGS
WHEELS AND TIRES

The body of the car protects the driver and passengers from the weather and keeps them safe and comfortable. It also protects the parts of the car that make it go.

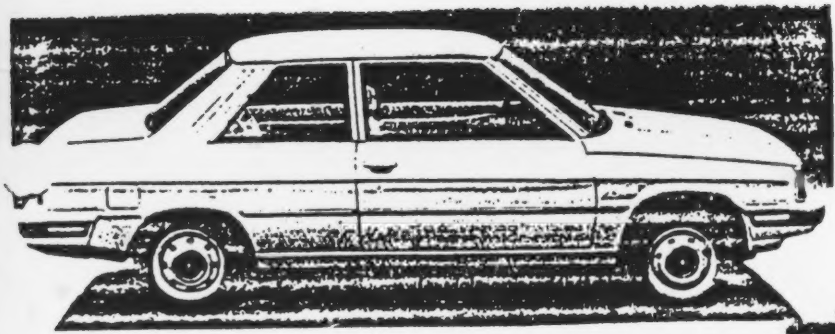
The way the car body looks is called its style. Although cars look very different they can be grouped into one of six basic body styles. It is important for the Auto Body Repairperson to be able to tell the body style of a car so that he orders the right parts to fix the car.

ACTIVITY 1 will help you see how cars are different in body style. Open the envelope for style trial and carefully read the directions. You can use the next page to write down your answers.

WORKSHEET A1a

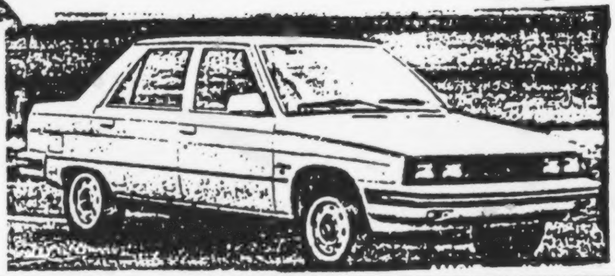
BMC BIG MOTOR COMPANY	LMC little motor company
CASE 1	
CASE 2	
CASE 3	
CASE 4	

WORKSHEET A1b

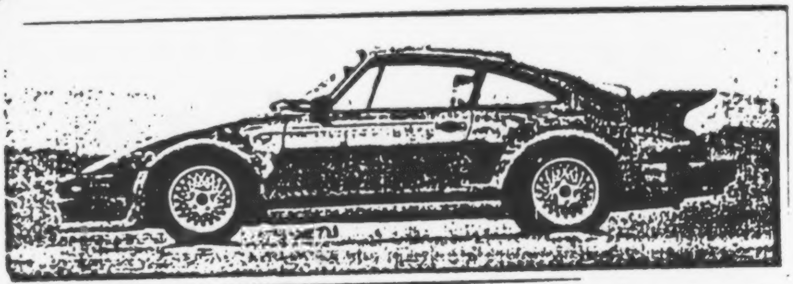


BMC

LMC

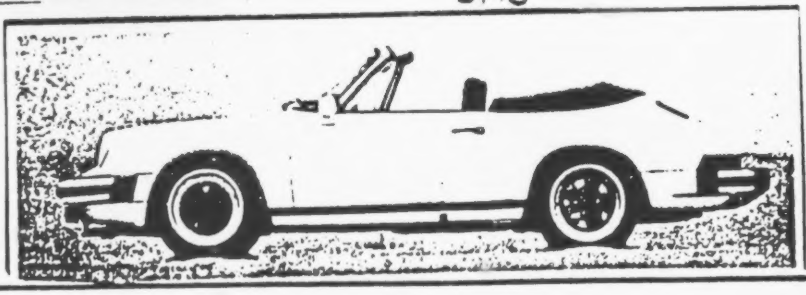


CASE 1



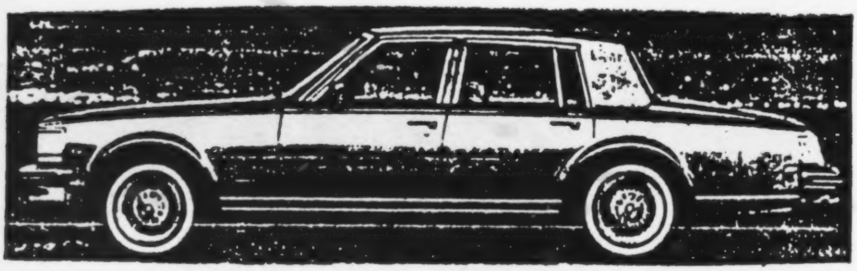
LMC

BMC



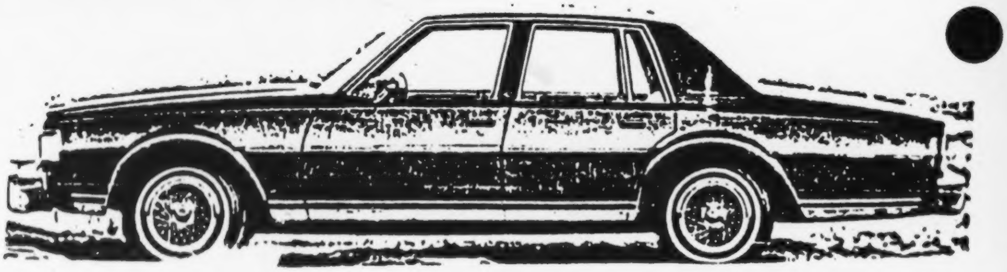
CASE 2

WORKSHEET A1c



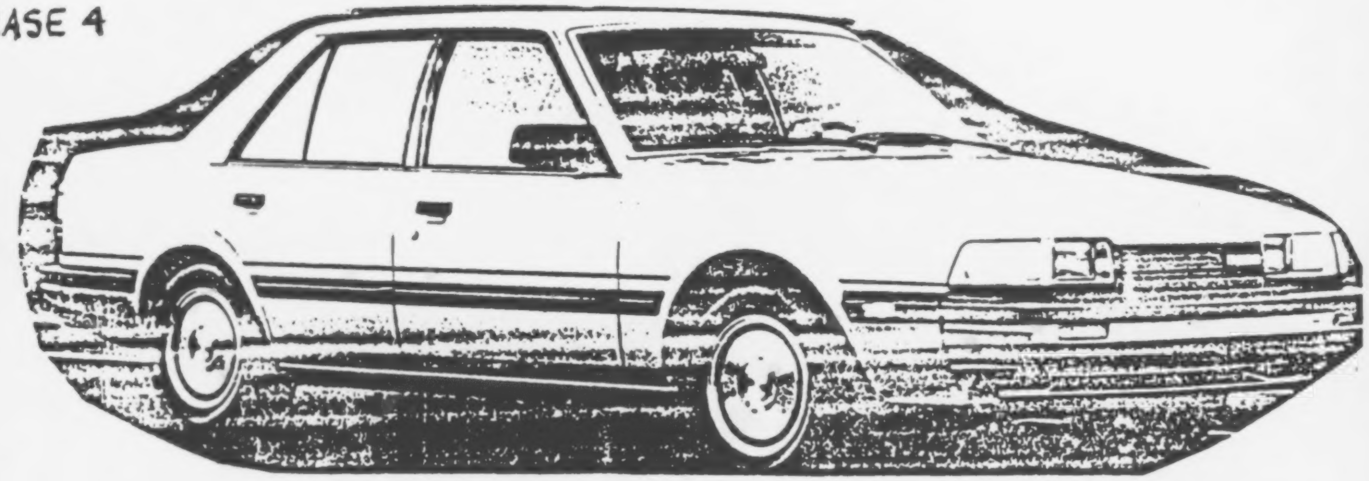
BMC

LMC

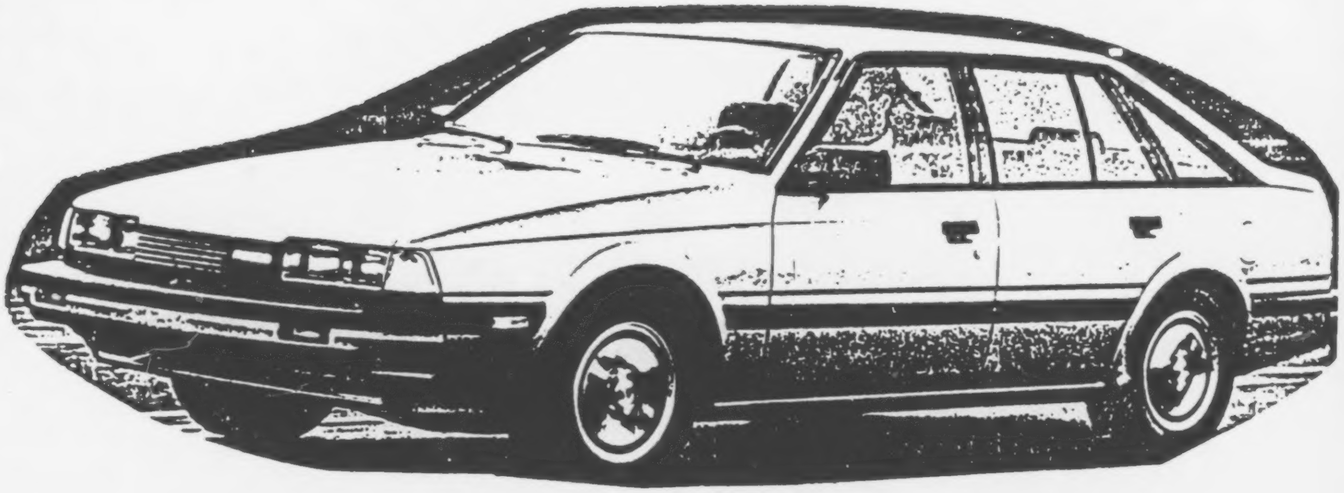


CASE 3

CASE 4



BMC



LMC

CASE 1: The judge notices the BMC car has 2 doors and the LMC car has 4 doors. Did you?

CASE 2: The judge sees that the BMC car is a convertible and the LMC car has a hardtop. Did you?

CASE 3: The judge thinks both these cars are the same. Did you point out how the roof and back window areas are different?

CASE 4: The judge notices one of the cars has a slanted back while the other doesn't. Did you also show the judge how the window areas are different?

SHOW WHAT YOU KNOW!

1) What main purpose does the auto body have?

2) Why must an auto body repairperson be able to recognize body styles?

3) What features are most helpful in knowing a car's body style?

Activity One helped you look for differences in the body style of cars. Body styles can be different in many ways. What are some of the ways body styles were different in Activity One?

____

____

____

Body styles can be different in the number of doors, the type and shape of the roof, and the size and shape of the windows. These things help us know what body style a car has.

Cars with the same features can be grouped together. They don't have to look exactly the same to belong to the same body style group.

Activity 2 will help you look for features that are the same or similar in cars.

Your teacher has the pages for Activity 2. Read the directions carefully after your teacher gives them to you.

WORKSHEET A1

Activity One

STYLE TRIAL

DIRECTIONS: You are the famous lawyer Otto Moe Bille. You have been hired by Little Motor Company, LMC, to help them in court. LMC is being sued by the Big Motor Company, BMC. BMC says LMC has copied their cars. You have to prove LMC cars are different. To prove this you have pictures of two cars, one a BMC model, the other an LMC model. Look at each car. On worksheet A1a, write down how the cars are different. You will have four cases.

READY?

Look at the cars for CASE 1.

WORKSHEET A2

Activity Two

VEHICLE VALET

DIRECTIONS: You have been hired by a big Country Club as a vehicle valet. This is what they call their car parkers. The manager, Ima Wright, likes everything done her way. She wants cars parked in certain parts of the lot. She has color coded the lot. You are to park the cars as follows:

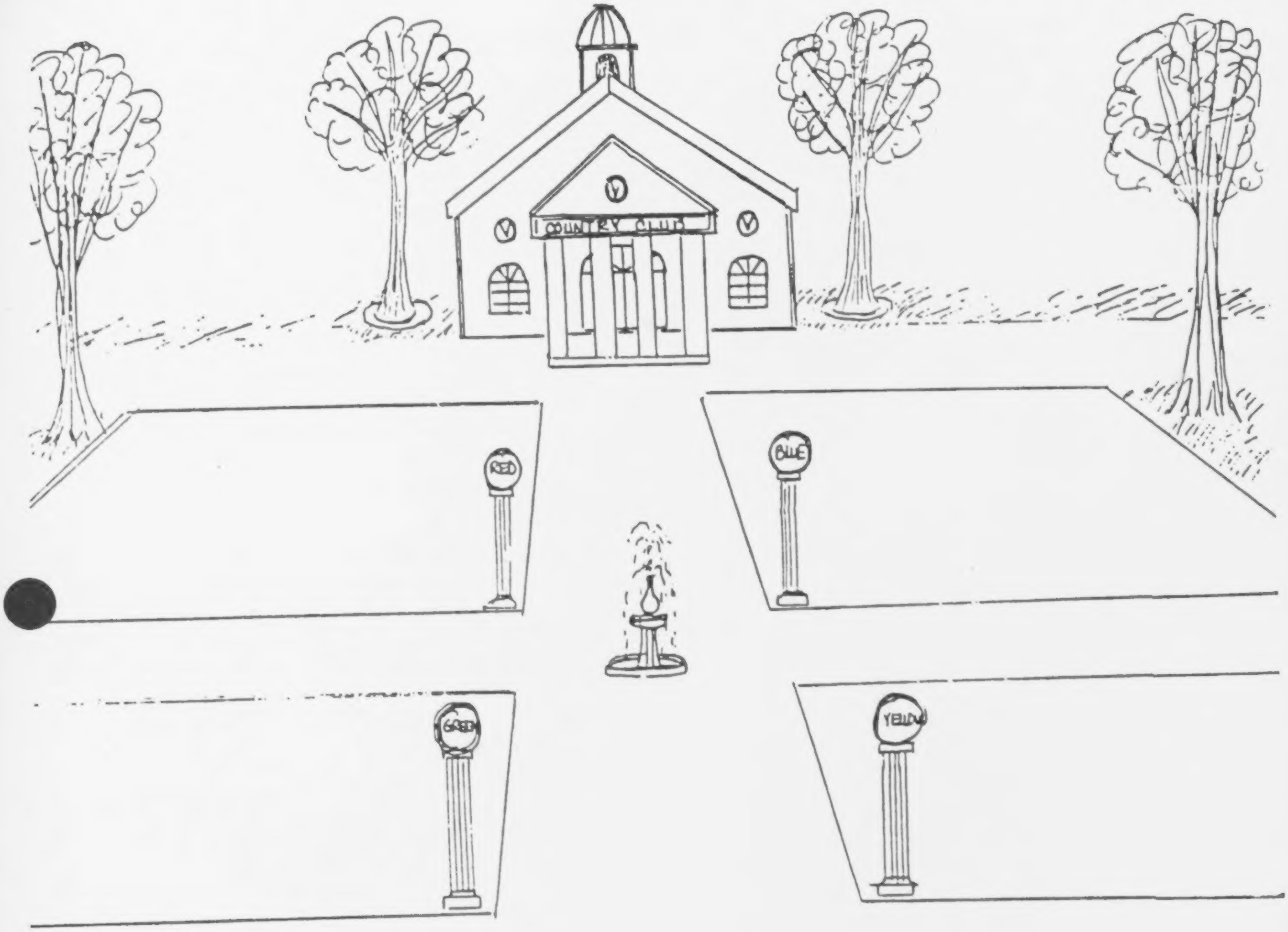
Two Doors - Red Lot
Four Doors - Blue Lot
Convertibles - Yellow Lot
Station Wagons - Green Lot

Write the car number from Worksheets A2b, A2c, A2d and A2e in the right parking lot on the map.

Got it? Look at car 1.

WORKSHEET A2a

VEHICLE VALET


COUNTRY CLUB
RED
BLUE
GREEN
YELLOW

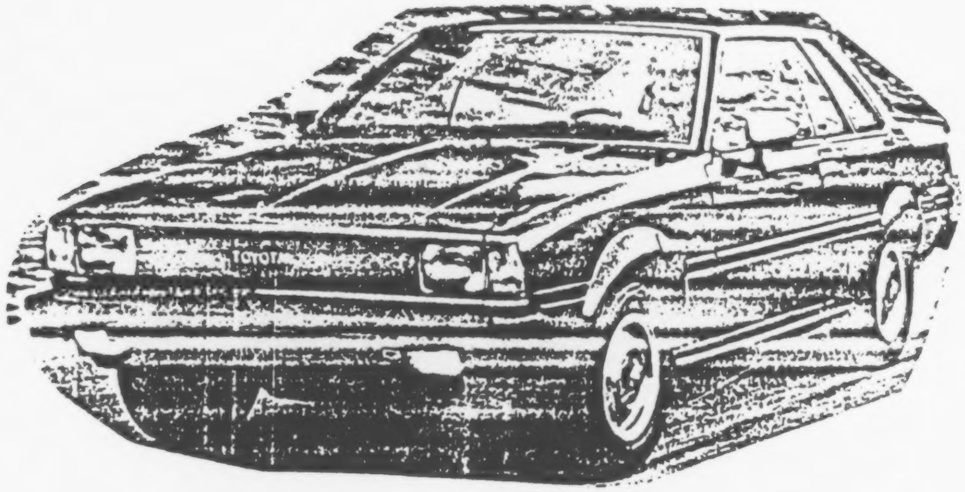
LOT COLOR CODE

Two Doors	Red Lot
Four Doors	Blue Lot
Convertibles	Yellow Lot
Station Wagons	Green Lot

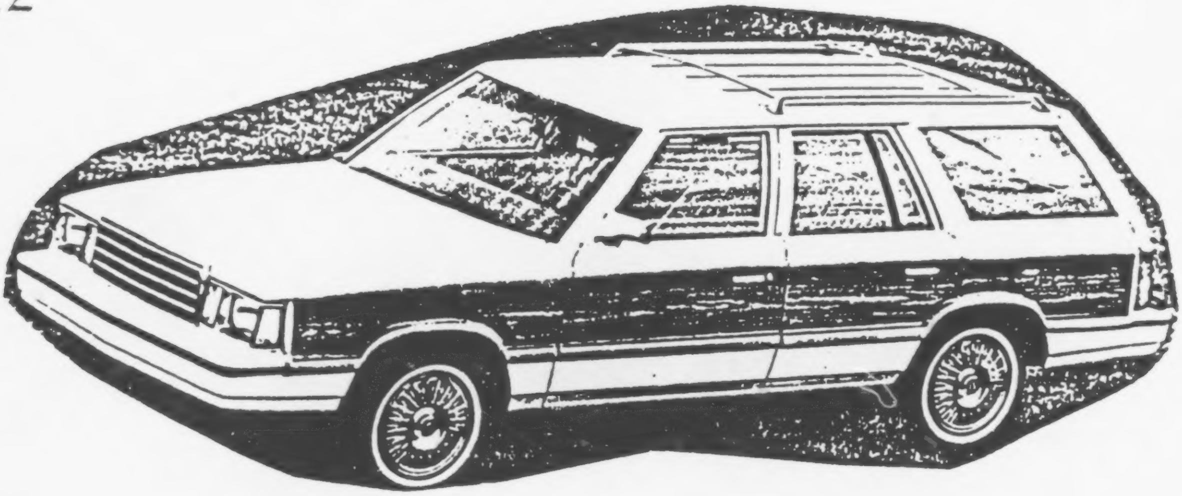
(After you have completed this activity, check your answers with the correct answers at the bottom of page.)

WORKSHEET A2b

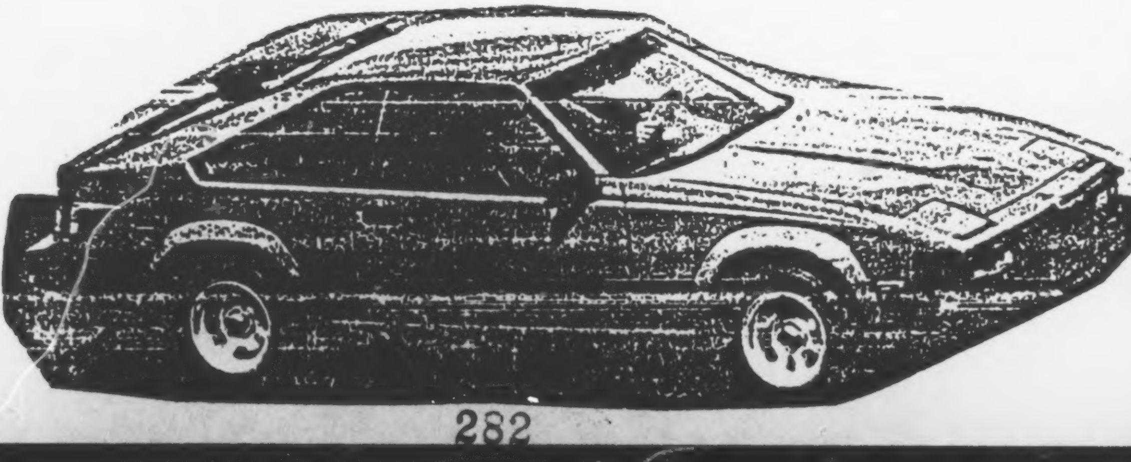
CAR 1



CAR 2

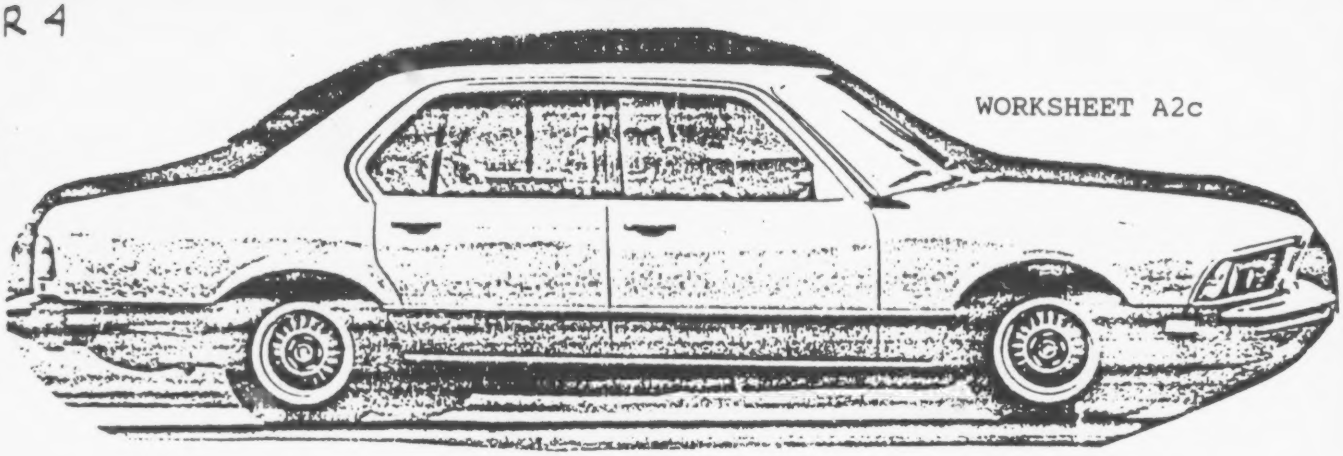


CAR 3

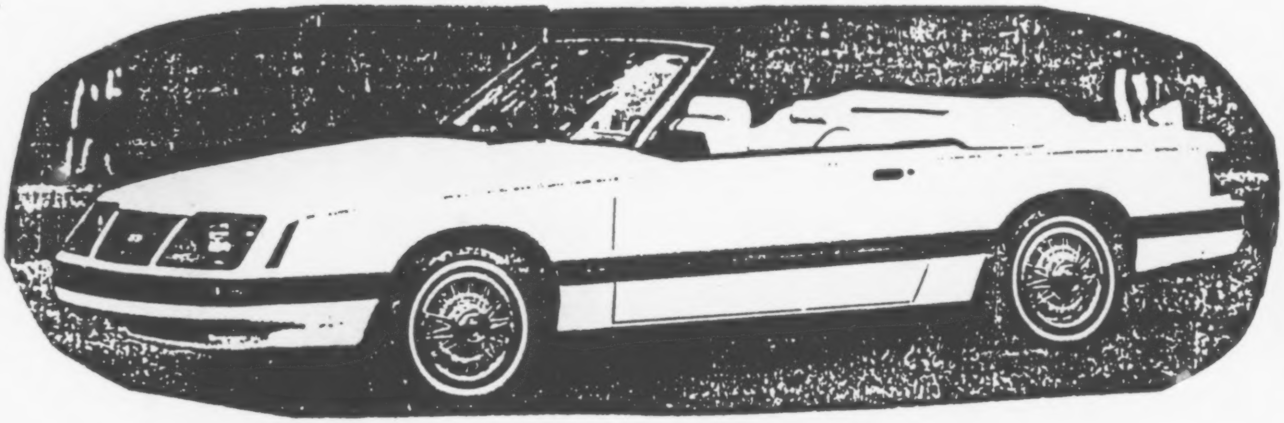


CAR 4

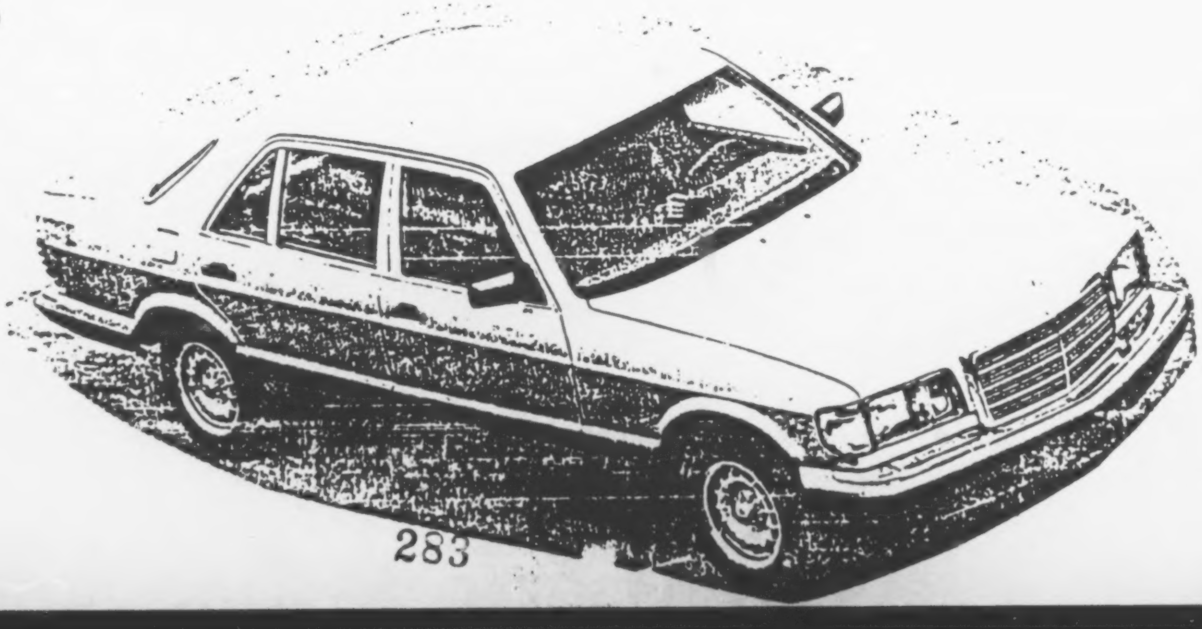
WORKSHEET A2c



CAR 5

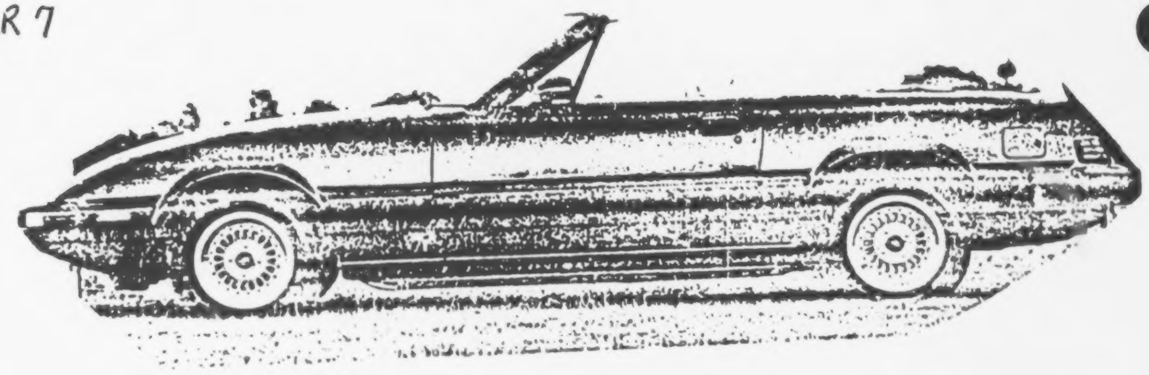


CAR 6

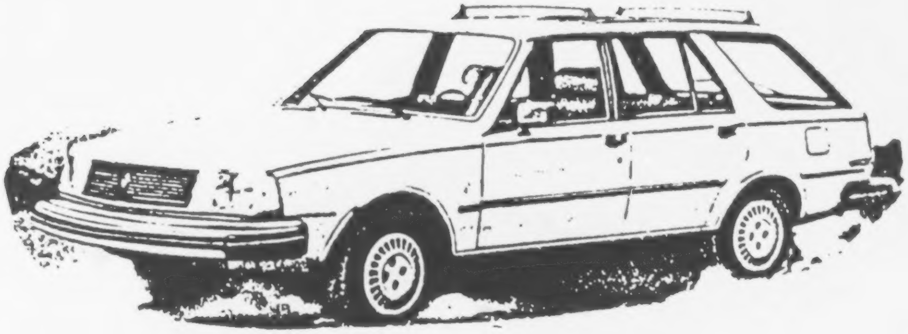


WORKSHEET A2d

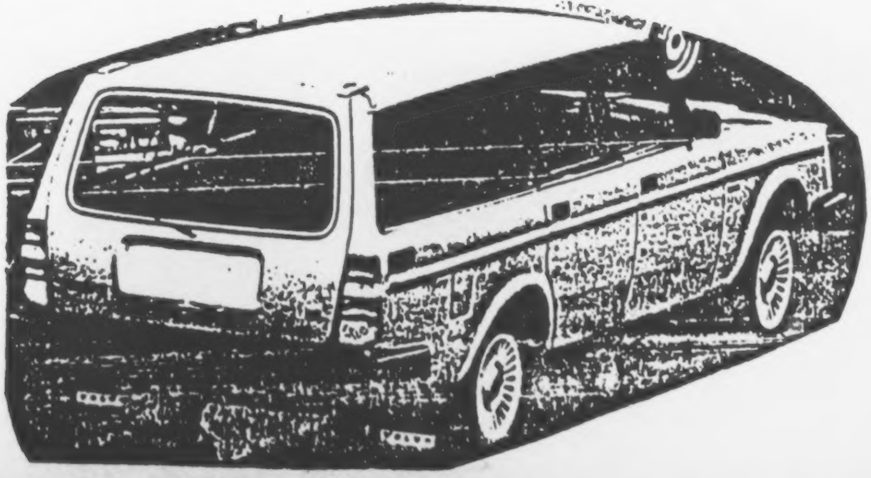
CAR 7



CAR 8

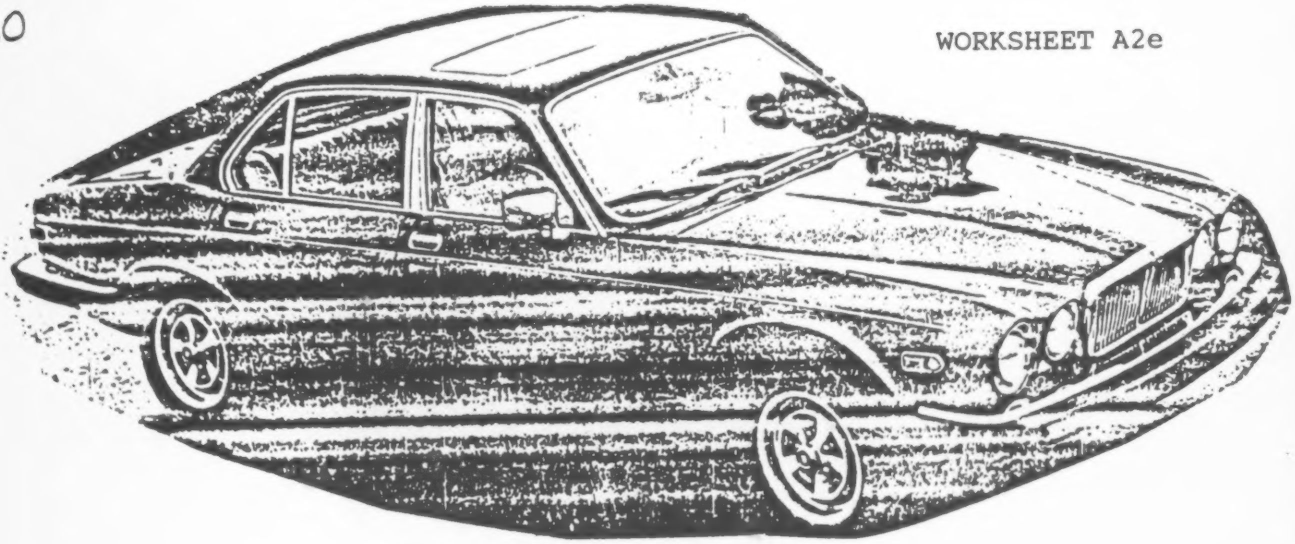


CAR 9

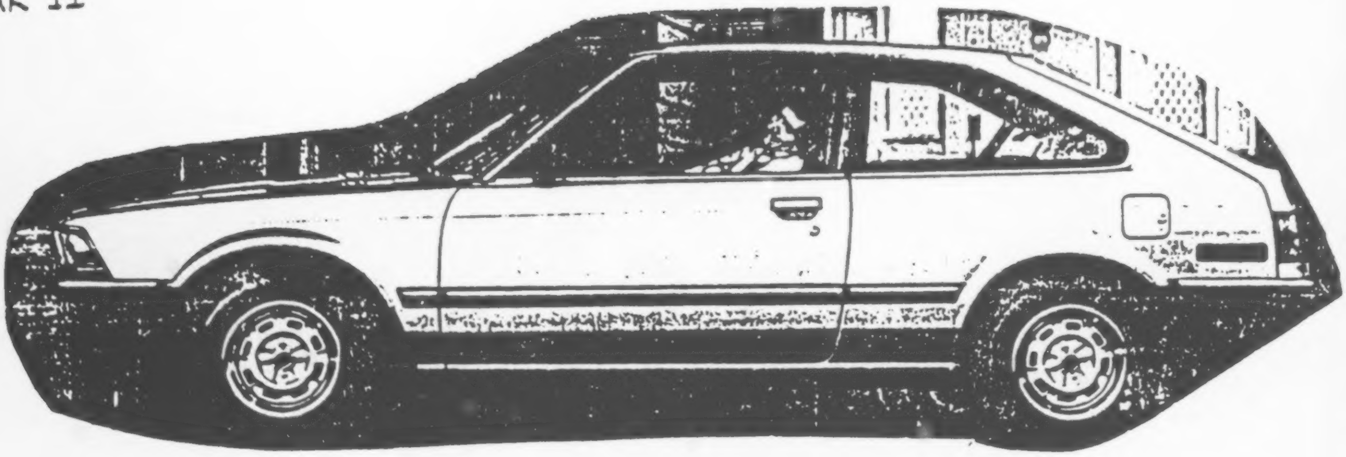


WORKSHEET A2e

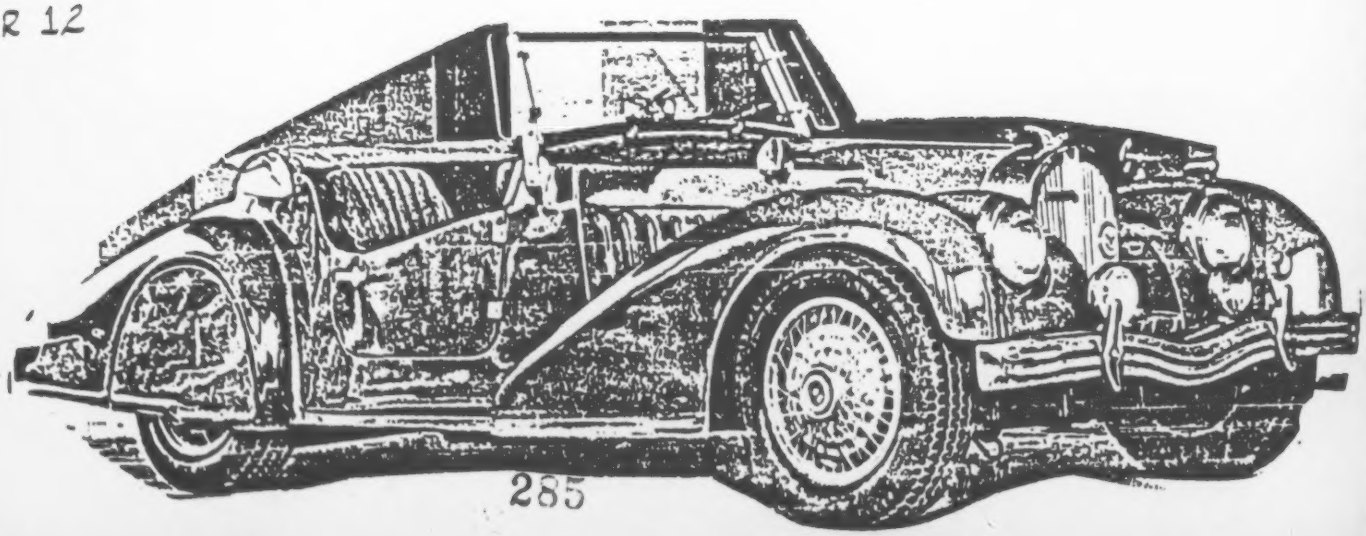
CAR 10



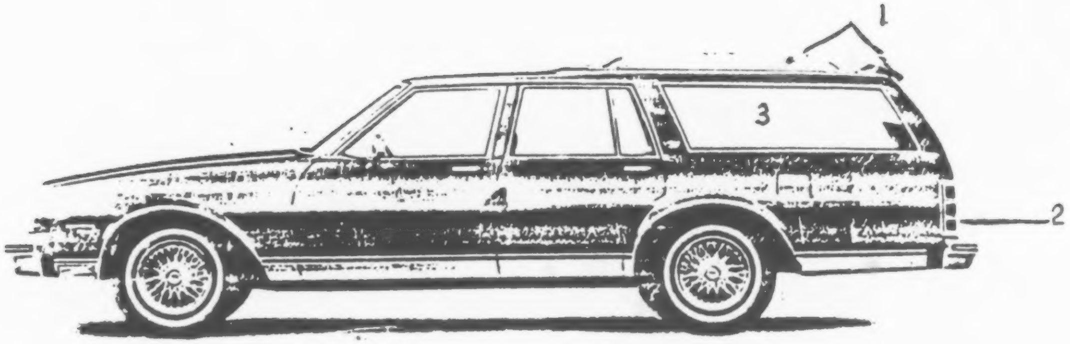
CAR 11



CAR 12



WORKSHEET B1



STATION WAGON

The features of a station wagon which help identify it are:

1.

2.

3.

4.

WORKSHEET B2

CONVERTIBLE

The main feature which identifies a convertible is:

1. ____

WORKSHEET B3

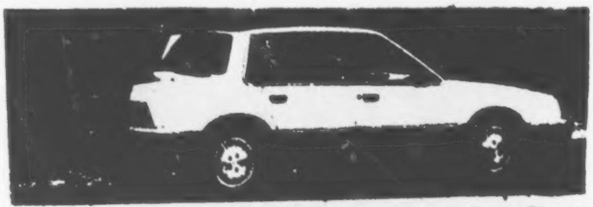
HARDTOPS AND SEDANS

TWO FEATURES THAT DIFFER: 1. ______________________

2. ______________________

HARDTOP HAVEN

"HAVE YOU DRIVEN A HARDTOP LATELY"



CALL · **765·4321**

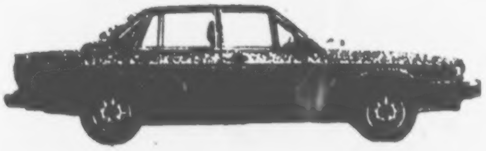
YELLOW Pages

FIND IT FAST. . .

Sultan of Sedan's

CALL **123-4567**

LATE MODEL SEDANS •Sam 'Sheik' Shaw•



WORKSHEET C1

BULLETIN BOARD SET-UP

2 DOOR SEDAN

2 DOOR HARDTOP

CONVERTIBLE

STATION WAGON

4 DOOR SEDAN

4 DOOR HARDTOP

WORKSHEET C2

STUDENT ______________________________

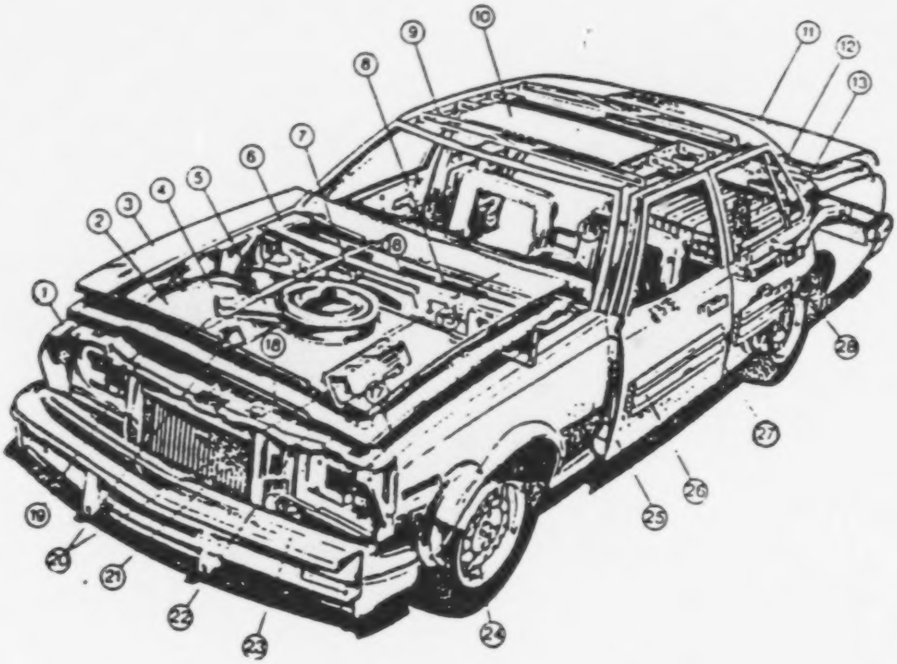
INTERSECTION ______________________ AND ______________________

PARKING LOT ____

2 DOOR SEDAN	2 DOOR HARDTOP	4 DOOR SEDAN	4 DOOR HARDTOP	CONVERTIBLE	STATION WAGON

UNIT TWO

PARTS SMARTS


1
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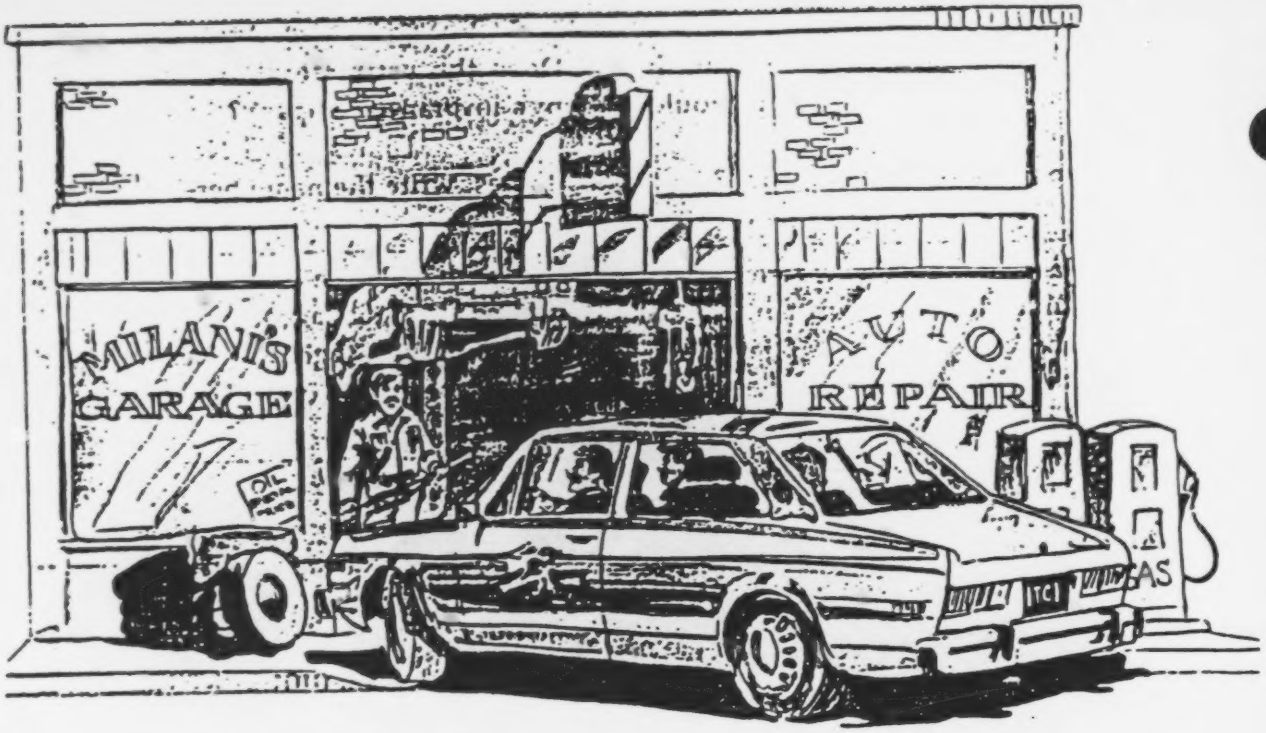
28

You have learned that a car's body protects the passengers and the car. You have learned that cars look different, but can be grouped by their body style.

In Unit Two you will learn about the many parts that make up the body of the car. You will learn the names of the most important parts and what they do.



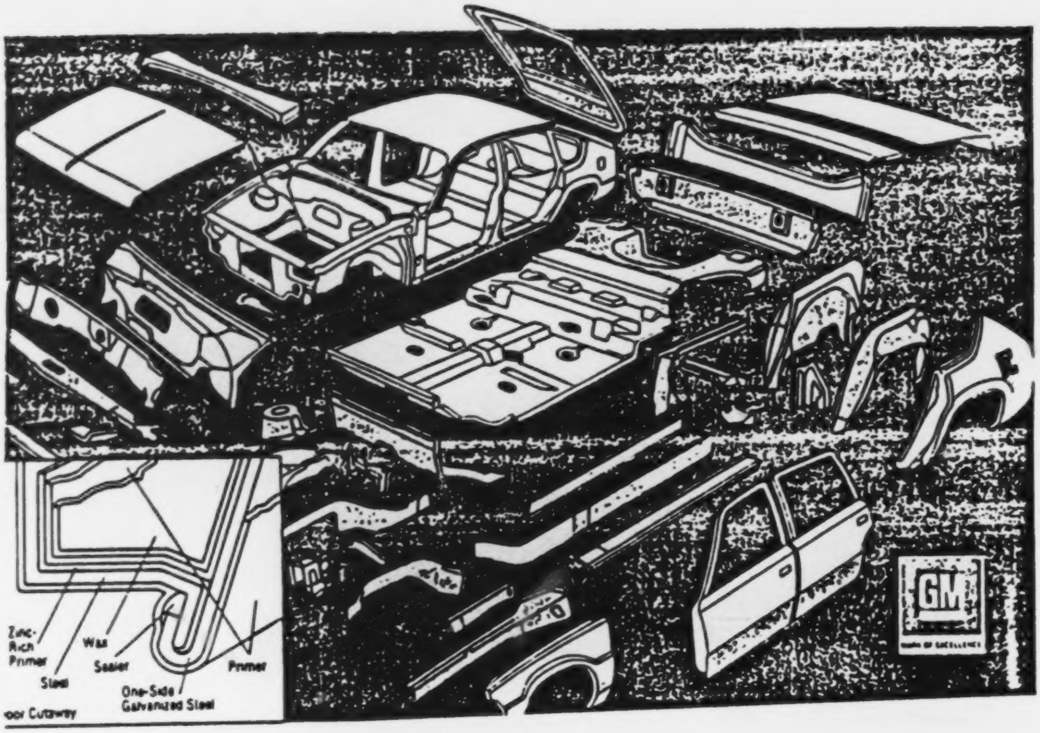
RRRING! . . .RRRING!

"Fender Menders, you bend 'em, we mend 'em. This is Ron. Can I help you?" "Yes, I need to get my car fixed before my husband gets home. I've already had the fence repaired."

"I see, ma'am. Tell me what the damage to your car is." "Well, that little doohickey on the whatchamacallit came off and the door doesn't open. I had to go out the other side." "I'm afraid you'll have to bring it in so we can see what need to be repaired . ."

Doohickeys and whatchamacallits are hard to order. What you call a doohickey might be a whatchamacallit to me. The auto body repairperson must be able to recognize the parts of the auto body so that he or she can order the right ones. Each part has its own name. We will learn the main parts of the auto body.

When a wrecked car is brought to the auto body repair shop it must be decided which parts need to be fixed and which need to be replaced. To be able to do this, the auto body repairperson has to know how the parts of the car are put together.


Zinc-Rich Primer
Steel
Wax
Sealer
Primer
One-Side Galvanized Steel
oor Cutaway
GM

This picture shows the major body parts of a car. Each fits together like the parts of a model. How they are put together is important to the auto body repairperson. It will make a difference in fixing the car. Some parts are welded together while others are bolted together. Activity 3, Hollywood Hotrod, will help you see how the parts of a car fit together.

UNIT TWO

Activity Three

HOLLYWOOD HOTROD

The great Hollywood stuntman, Lou Knee, has hired you to make a stunt car for a scene in his movie, "Last of the Hot Rod Lovers." In the scene, Lou will drive a car off a mountain road, down an Olympic ski jump, fly through the air, and land on the road at the base of the mountain blocking the bad guys' get away. You have studied the problems this stunt has and have a design for a stunt car. To show Lou and the producer how the car will work, you decide to draw a model of it.

ACTIVITY THREE

FOLLOW-UP

Now that you have finished the drawing of the car and shown it to Lou Knee, the producer of the movie, Celica De Ville, calls you into his office.

Mr. De Ville tells you he likes the stunt and he likes the car, but he doesn't like the cost. He wants you to cut down the cost by leaving some of the parts off the car. Parts that aren't really needed.

What would you say? ______________________________

____

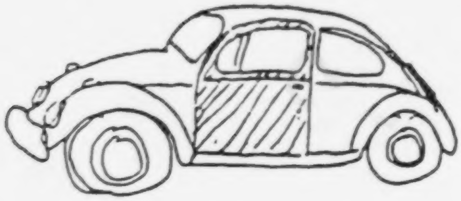
____

____

All the parts of the car are important. Many give strength to the car to protect people in accidents. Some protect other parts from dirt and water. Others are made to cut through the wind so the car runs better and uses less gas. Activity 3 helped you see that there are many parts to a car. Now we will learn the names of many of these parts and what they do.

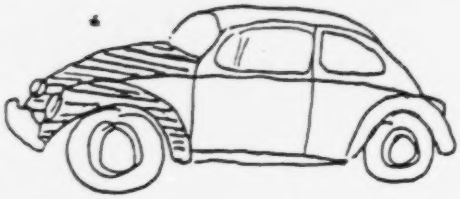
The parts of the autobody can be looked at in groups. The basic groups and the parts of those groups are:

1. Hinged Components



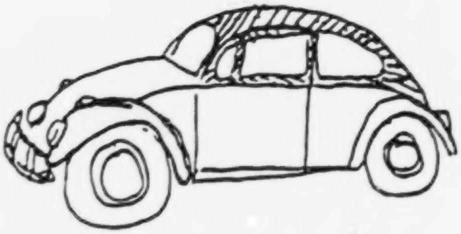
DOORS, TRUNK LIDS, TAILGATES

2. Front End Components



HOOD ASSEMBLY, FRONT FENDERS

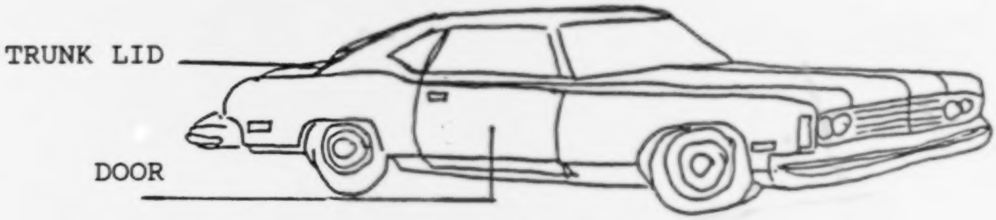
3. Roof Components



ROOF PANEL, PILLARS, ROOF RAIL/EXTENSION PANELS

HINGED COMPONENTS

Doors, trunk lids, and tailgates are in the first group of components (parts). These parts must open and close to let people get into or out of different areas of the car. To open and close they are attached to the car on hinges. Because of this they are grouped together in this lesson. These parts are complex because they have many smaller parts which are needed to open and lock them.



(TAILGATE NOT SHOWN)

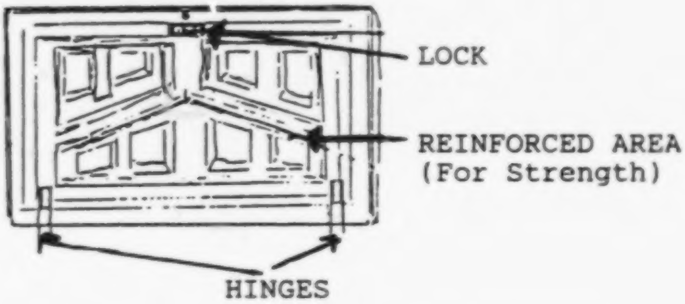
DOORS - Cars will have two or four doors. The main purpose of the door is to let people into the passenger (seating) area of the car. The doors also hold the car windows in place. The windows are important for visibility (seeing around) and ventilation (air flow).

The doors are strong because they must protect the passengers in an accident. Doors are often damaged in accidents and must be carefully repaired, so that they work properly. Below are the working parts of a door. You can see why everything must be carefully fixed.

HINGED COMPONENTS

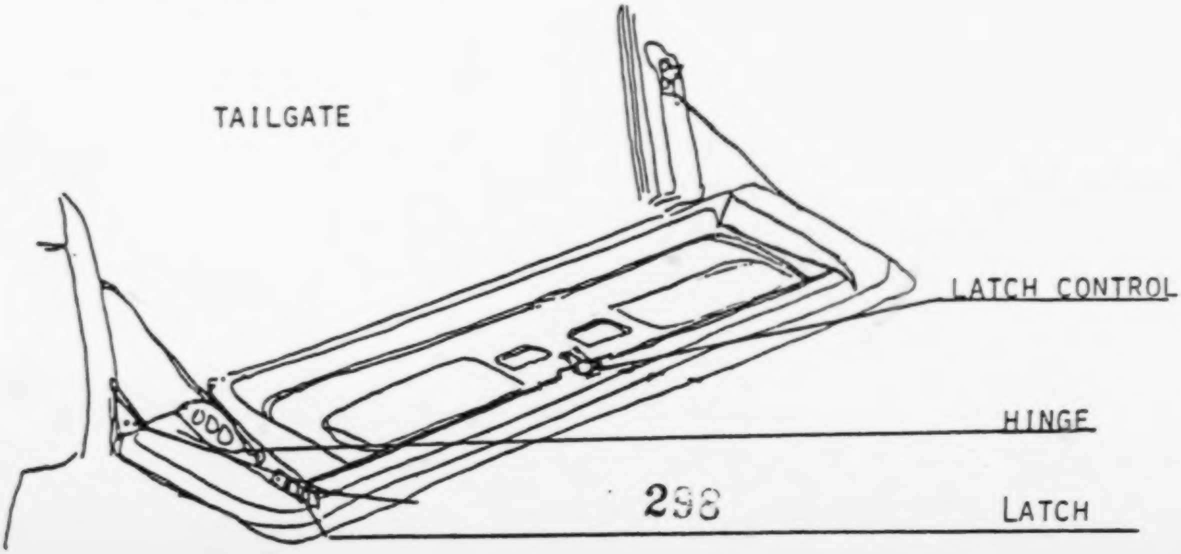
Trunk lids are hinged so that people can open them to get into the main storage area of the car, the trunk. When closed the trunk locks to provide a safe storage space. It protects items from the weather and theft. Because many accidents happen because people back into cars or are hit from behind by another car (rear end collisions), trunk lids often need fixing.

TRUNK LID



Tailgates are a rear end door found on station wagons. They are hinged so that a person can get into the cargo (storage) space in the back of the car. A station wagon does not have a trunk. The tailgate is very similar to a trunk lid, but has a latch on both sides instead of one in the middle. This means it has more parts to open and close it.

TAILGATE



HINGED COMPONENTS

NAME THAT PART

Match the name of the part in the first column with the function (what it does) in the second column by placing the correct letter on the line.

_____ 1.	DOOR	A.	Found on station wagons. Opens to allow person to get into cargo space.
_____ 2.	TRUNK LID	B.	Opens to let people into passenger area. Holds car windows in place.
_____ 3.	TAILGATE	C.	Opens to allow people to use hidden cargo space--the trunk.

FILL IN THE BLANKS

Use the words below to fill in the blanks.

The group of parts which open and close are called the ____________________ ____________________. The part which opens to let passengers into the seating area of the car is the ____________________. The parts which open to let you into the storage area of the car are the ____________________ on a station wagon and a ______________ ______________ on other cars.

WORDS

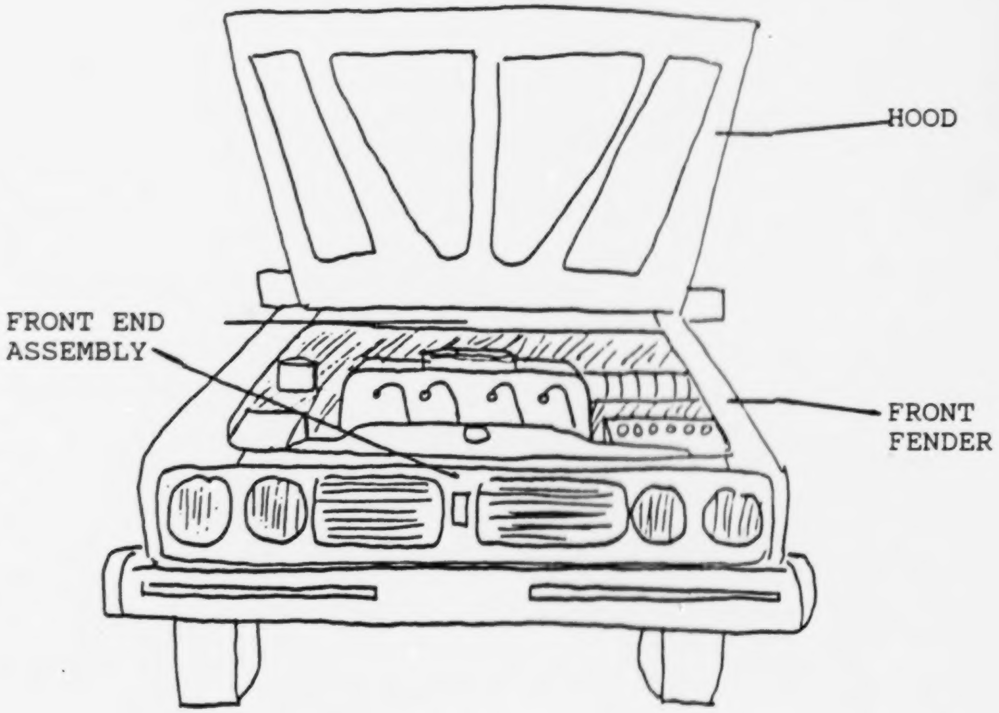
HINGED COMPONENTS
DOOR
TAILGATE
TRUNK LID

FRONT END COMPONENTS

The front end components of a car are the front fenders, the hood, and the hood assembly. These parts protect the engine from the weather and help the car cut through the wind and save gas.

The hood is mounted on hinges so that it can be opened to get into the engine. It covers the engine of the car for protection.

The fenders are a housing for the front wheels. They help keep mud and water out of the engine and from being splashed up onto the car by the wheels.



FRONT END COMPONENTS

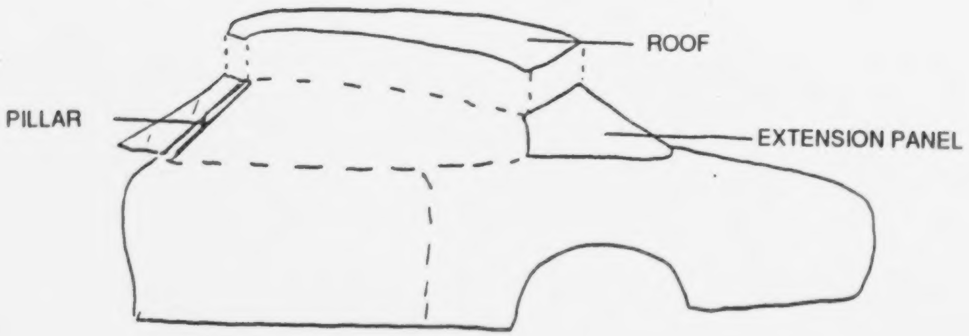
REVIEW: Fill in the blank with the correct word.

1. The ____________________ is hinged to let you get to the engine when opened and to protect the engine when closed.

2. The ____________________ house the front wheels to protect the car from mud and water splashed up by the wheels.

3. The hood attaches to the ____________________ by hinges and a latch.

ROOF COMPONENTS



The roof components join to protect the passenger area from the weather and from injury in an accident. The roof design can be different in cars but most have a solid roof connected to the car with pillars and extension panels.

Roof panel covers the passenger area of the car and is reinforced to protect from injury if an accident caused the car to roll over.

Pillars and extension panels support the roof panel and house the windshield and rear window. They must be strong for protection but must be small so the driver can see all around (visibility).

NAME THAT PART: Match the part with its function by placing the letter next to the number of the correct part.

_____ 1. ROOF PANEL	A.	Houses rear window - supports roof.
_____ 2. PILLAR	B.	Covers passenger area to protect from weather or injury.
_____ 3. EXTENSION PANEL	C.	Houses front windshield - supports roof.

REAR QUARTER PANELS

The section of the car from behind the doors to the rear bumper is the quarter panel. The quarter panel houses the rear wheel and protects the car from mud and water like the front fender. The quarter panel provides strength to the rear of the car.

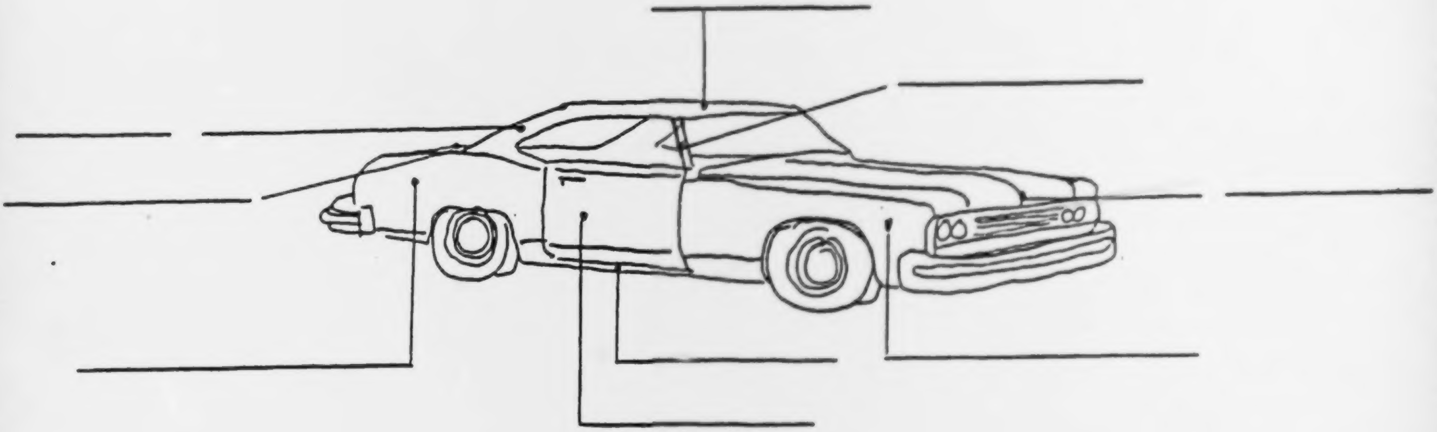
ROCKER PANELS

Rocker panels are located below the doors. They add strength to the auto body. Because of their location they are easily damaged by curbs or rust out from water and mud.

The underbody and cowl panels cannot be seen from the outside. These sections of the car are located inside the exterior. They provide strength to the automobile and enclose the passenger section of the car. They are similar to the floors and inside walls of a house.

WORKSHEET E1

Write the correct component name on the lines below using the words in the word box.



WORD BOX

Roof
Windshield Pillar
Hood Assembly
Front Fender
Rocker Panel
Quarter Panel
Trunk Lid
Extension Panel
(Roof Rail)
Door

Give the function for each of these parts.

ROOF ____

WINDSHIELD PILLAR ____

HOOD ASSEMBLY ____

FRONT FENDER ____

QUARTER PANEL ____

ROCKER PANEL ____

TRUNK LID ____

EXTENSION PANEL ____

DOOR ____

INSTRUCTIONAL MODULE

ACCESS SKILL: PERFORM BASIC OPERATIONS OF DECIMALS AND PERCENTS ACCURATELY

TASK ANALYSIS STEPS: A-P

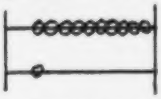
VOCATIONAL AREA:
Autobody
Auto Mechanics
Building Trades
Electronics
Machinist

ACTIVITY	MATERIALS/RESOURCES
TASK A: The student will define the term decimal and give an example of one from his/her daily life	
1. Introduce the unit on decimals by defining a decimal and telling the students that using decimals provides an efficient way of expressing any fractional number or portion of a whole. Follow-up: Contact the parents of the student(s) and let them know that the student is learning about decimals and needs to find ways in which he/she uses decimals in his daily life--such as buying food, clothing, etc. (using money), measuring objects in tenths or hundredths, paying bills, measuring the amount of carpet needed to carpet a room, and so forth. Measurements of pounds and ounces on boxes and cans of food are given in decimal notation and can be compared.	
2. Give students a piece of graph paper and ask them to mark off 10 squares top to bottom and 10 squares side to side. Then they should cut out the squares (100 all together) in one piece. Have them do the same with a second piece of paper and then cut the 10 squares into strips. Have the students line up the 100 square pieces using the smaller strips beside it to show tenths. Show the students how 100 squares = 1 whole and each strip (10 squares) equals .1 (one tenth) of that whole.	Graph paper, scissors
3. Using cuisenairre rods, break the students into groups of 2 or 3 and call out a certain number which the students are supposed to design from their cuisenairre rods. For example: if you say 5.2, the students should get 5 whole rods (10 squares in length) and 2 small squares (one square in length each). Putting these squares in a row makes 5.2.	Cuisenairre rods available from the College of Education Instructional Materials Center, UMC
4. Review what a decimal is and have the students who are still confused look it up in the dictionary.	
5. Use a number line with whole numbers and decimal points to point out the whole numbers vs. the decimal units.	
TASK B: The student will successfully explain the concept of decimal notation through tenths	
1. Give students a chance to be teacher for the day and have them teach someone else how to read numbers with decimals notations up to tenths. Write some numbers on the board and assign the students in pairs to teach the steps you use when reading decimal notation.	

ACTIVITY | MATERIALS/RESOURCES

TASK B: CONTINUED

2. Use an abscissa to demonstrate tenths. Push ten markers on the abscissa over to one side of the line. Then explain to the students that that is one line. Next push 1 marker at a time over to the line beneath the full line and ask the students to explain or call out the tenths that are made. For example:



10 parts = 1 whole

1 tenth

Then ask the students to write that number as a decimal.

TASK C: The student will accurately read and write decimals through hundredths

1. Write some numbers on the board using decimal notation. For example: 5.7, 8.9, 10.3, etc. Ask the students to raise their hand when they can call out the correct number written --stating it as a decimal notation.

2. Ask the students to go to the board and see who can write the decimal quickest. Call out the following decimals and others and see who can write them as you say them. For example: Call out, "seven and nine tenths." The student should write 7.9, etc.

3. Make some bingo sheets with various decimals written on them. (You might want to laminate the sheets so higher numbers can be used for the same game later on.) Put strips of paper with the same numbers on them as appear on the Bingo game in a box. One at a time pull out a number and call it out. See which student can get Bingo first. Let students be the leader or caller of the numbers from time to time so you can test their ability to read the numbers correctly.

4. Using 5 pieces of paper or tagboard, write numbers on each and mix them up to get a different number each time. You will place the pieces of paper on the chalkboard (using tape) with a decimal point somewhere on the board to show tenths or hundredths. For example:

5|4|6 . 8|2 or 8|6|4 . 5|2

Point out to the students that it does not matter which number is in which place, the numbers to the right will be tenths and hundredths.

TASK D: The student will accurately read and write decimals through thousandths

1. Draw a number line on the board and mark the columns to the right of the decimal place as tenths, hundredths, and thousandths. Then review the tenths and hundredths columns from previous lessons. Introduce the thousandths column and talk about how that column is used and by whom (machinists, baseball players, technicians, lab workers, pipe fitters, etc.). Call out some numbers and ask which column they should be placed in. For example: Call out "one hundred forty-three and 324 thousandths". Write the numbers under the columns discussed above to demonstrate the columns of decimals.

ACTIVITY

MATERIALS/RESOURCES

2. Give the students worksheets with various numbers on them--using decimal notation to the thousandths. Ask the students to accurately read the numbers given.

3. Call out numbers with decimal notation to the thousandths and tell the students to write the numbers as they hear them. Check to make sure the student can accurately write 8 out of 10 numbers correctly.

TASK E: The student will identify the greater or lesser of two decimals using the sign for greater than or less than

1. Discuss with students why it might be necessary to compare decimals. (To find the greater or lesser of the two). If a carpenter has to drill a hole, he wants to make sure it is the right size and may need to compare drill bits. He might compare .8880 to .555. Which would be the larger drill size? (.8880)

2. Demonstrate to the students by comparing two numbers in tenths, then hundredths, and then thousandths to clearly determine why one number is larger than the other.

   For example: $4.3 < 4.9$ because nine is more than three
   $4.37 > 4.32$ because seven is greater than two
   $7.810 > 7.803$ because the number closest to the numbers that differ are the 10 and the 03 and .10 is more than .03. The eights cannot be compared because they are obviously the same number.

3. Give the students worksheets with various numbers on them and ask the students to put the less than (<) and greater than (>) signs on them after accurately comparing the two numbers.

TASK F: The student will accurately solve addition problems involving decimals through thousandths

1. Write various numbers on the board which include the use of decimals. Add the two numbers as a demonstration.

   Chalkboard, chalk

   For example:
   $$\begin{array}{r} 0.7 \\ \underline{+1.2} \\ 1.9 \end{array}$$

   Once the students have done problems adding with decimals in a vertical manner, give them demonstration problems on the board in a horizontal manner.

   For example: $1.4 + 3.9 = \underline{5.3}$

2. Give the students worksheets with the above type problems on them. Students should be able to do 8 out of 10 or 16 out of 20 problems accurately without assistance before moving on.

3. Demonstrate working addition problems using decimals to the hundredths in the same manner as above.

4. Demonstrate on the board or overhead projector adding decimals to the thousandths--using more than two numbers.

ACTIVITY

MATERIALS/RESOURCES

TASK F: CONTINUED

For example:

$$\begin{array}{r} 54.48 \\ 18.4 \\ 25.38 \\ 19.02 \\ \underline{+\ 6.43} \\ 123.71 \end{array}$$

Also give problems such as:

19.2 + 6.43 + 20.01 = ________

TASK G: The student will accurately solve subtraction problems involving decimals through thousandths

1. Provide the students with a demonstration of regular subtraction problems before beginning this portion of the lesson. Be sure in your discussions that everyone can subtract accurately.

2. Demonstrate subtraction of problems using decimals. Give the first few problems in which no borrowing is necessary such as:

$$\begin{array}{r} 0.86 \\ \underline{-0.23} \\ .63 \end{array}$$

and 0.94 - 0.43 = 0.51

Give the students worksheets, have them figure problems at the board, let them figure problems on large pieces of tagboard. Be sure the students can do 8 out of 10 problems before going on to subtracting more difficult problems (such as borrowing).

3. Introduce borrowing to the students just as they did when subtracting whole numbers. Make sure they understand that you begin subtracting from the right side and borrow from the number just to the left of that number. For example:

$$\begin{array}{r} 2.\overset{3}{\cancel{4}}\overset{1}{\cancel{3}}7 \\ \underline{-0.196} \\ 1.241 \end{array}$$

Review borrowing orally before assigning any individual work.

4. Give students vocational problems which require subtraction of decimal numbers. For example:

If the standard measurement of a cylinder is 3.625, and the cylinder you are measuring is 0.0122 over the standard, what is the difference?

3.625 - 0.0122 = ________

Follow-up: Ask the students to work with their parents at home to identify the differences in weight of two boxes of cereal, 2 cans of beans, 2 boxes of crackers, 2 cans of soup, 2 bars of soap, etc. The students should do this activity on their own or with parent assistance.

5. Give the students magic square problems to reinforce and use as a self-checking problem. The students complete something like Worksheet G5 when doing a magic square problem.

Worksheet G5

ACTIVITY	MATERIALS/RESOURCES

TASK H: The student will solve addition and subtraction problems involving money

1. Discuss with the students why it is important to be able to subtract money accurately. (Some answers might be: so you don't get cheated at the store, so you can do your job if it requires making change, so you can fill out an order form accurately, etc.)

2. Give students a menu from a local restaurant and ask them to pick out 6 items they would order if they could go out to dinner. Have them circle those items. Then ask them to find the differences in price of all six.

   Menu from local restaurant

3. Point out to the students that each penny is one hundredth of a dollar, and that is written $0.01.

   Follow-up: Ask the parents to become actively involved in the student's knowledge of money and the differences when subtracting by bringing out their last two electric bills and helping the student find the difference. (They might even want to discuss the reasons for the differences.)

4. Give the students worksheets in which they must add and subtract with money. For example:

$$\begin{array}{r} \$3.75 \\ \underline{-0.68} \end{array} \quad \text{and} \quad \begin{array}{r} \$6.98 \\ \underline{+3.27} \end{array}$$

5. Ask the students to find the total points earned by a figure skater, olympic runner, etc. Then to find the score of another person in the same event and finally to find the difference.

6. Time students in the 1 mile run two different times. Have the students write down their time on each run and then figure the difference.

TASK I: The student will accurately solve problems in multiplying decimals

1. Discuss the proper method of multiplying whole numbers and point out that multiplying decimals is done the same way. Demonstrate where the decimal point goes in multiplying (the number of numbers appearing to the right of the decimal point in both the multiplier and the multiplicand tells you the number of numbers which will be to the right of the decimal point in the answer).

   For example: $\begin{array}{r} 3.678 \\ \underline{\times\ .9} \end{array}$ has 4 numbers to the right of the decimal point

2. Give the students problems to figure such as:

   Find the perimeter of a baseball field when each side is

   26.50 ft. (26.50 x 4 = ________)

   If a gallon of gasoline costs $1.16 and you bought 4.5 gallons, how much would the gasoline cost? $\begin{array}{r} \$1.16 \\ \underline{\times\ 4.5} \end{array}$

ACTIVITY	MATERIALS/RESOURCES

TASK I: CONTINUED

Follow-up: Ask parents to work with the student in figuring how much their light bill would be if each kwh = $0.67 and they had their lights on for 5.2 hours each night. Ask parents to figure their bills to the detail and encourage the student to work with them to be able to figure their own bills.

TASK J: The student will accurately solve division of decimals

1. Review division and the process to use. Then point out to the students that division using decimal notation is no different as far as the numbers are concerned, but the decimal must be moved to the far right of the divisor and then as far right on the dividend as you moved it on the divisor.

   For example: 2.36)4.821 Move the decimal point two places to the right in both the dividend and the divisor, so that the divisor is a whole number. Place the decimal point in the answer in the same position that it appears after moving it in the dividend.

   Work a few example problems on the board for explanation.

2. Give the students worksheets involving division of numbers with decimal notation and make sure they can do 80% accurately without assistance before moving on.

3. Give students word problems involving decimal notation. For example: If you have 12 sheets of metal that are 48.12 inches wide all together, what is the width of each?

TASK K: The student will accurately solve equations involving decimals

1. Review all of the problems and ways to solve problems of numbers with decimal notations (addition, subtraction, multiplication, and division) and make sure the students can complete these types of problems with 80% accuracy before going on.

2. Give the students worksheets such as the following:

4.32	+		=	8.18
-	▨	-	▨	-
2.49	+	3.07	=	
=	▨	=	▨	=
	+	.79	=	

   and so on with multiplication and division problems.

TASK L: The student will accurately estimate the value of a decimal

1. Discuss with the students the methods of estimation and how you estimate a number (round it off). For example: .678 is estimated to be .7 because it is closer to .7 than to .6 due to the numbers 7 and 8 being higher than 5. Show students several examples before asking them to perform this task.

ACTIVITY	MATERIALS/RESOURCES

TASK L: CONTINUED

2. Give the students several problems involving estimating using decimals such as the problem above. Then ask the students to perform the basic operations and estimate the answers.

For example: $\begin{array}{r} 2.33 \\ \underline{+1.69} \\ 4 \end{array}$ (the answer is estimated to be 4)

$\begin{array}{r} 2.39 \\ \underline{\times\ .42} \\ 2 \end{array}$ (the answer is estimated to be 2 because .42 is less than 1 and 2.39 is closer to 2 than to 3)

TASK M: The student will accurately convert decimals to fractions and vice versa

1. Explain to the students that a decimal and a fraction are simply two different ways to show or express a portion of something. They equal each other when figured accurately. For example:

$$3/4 \;=\; \begin{array}{r} .75 \\ 4\,\overline{)\,3.00} \end{array}$$

If you have a decimal and want to express your answer as a fraction, you simply divide your decimal by 100 or 1000--whether your number is expressed as hundredths or thousandths.

For example: $\frac{75}{100} = \frac{3}{4}$

2. Work some sample problems on the board and then assign various problems for the students to do on their own.

TASK N: The student will accurately write decimals as percents

1. Explain to the students that two place decimals can be written as percents and percents as decimals. Give the students a few examples. For instance:

$$.66 = \frac{66}{100} = 66\%$$

Put some numbers on the board and let students decide what the percentage, the decimals, and the fractions would be written for various numbers.

2. Give students problems in which the decimal number is given and they must write it as a percentage. For example:

.43 = _____%   .09 = _____%

3. Give students problems in which the decimal number is given and the students must convert them to decimals. For example:

22% = 0._____   6.5% = 0.0_____

4. Give the students problems in which the decimal and percentage are given and the student must convert it to fractions.

ACTIVITY	MATERIALS/RESOURCES
TASK O: The student will accurately round off decimals	
1. Discuss with the students how to round off whole numbers to the nearest number 1, 10, 20, etc.	
For example: Is 4 closer to 1 or 10? 1 , so we round it off to 1.	
Then talk about rounding off numbers when they have a decimal notation.	
For example: Is 2.68 closer to 2 or 3? (3)	
2. Do several problems on the board until it appears that everyone has a clear grasp of the idea. Then assign work either from the board or on paper.	
TASK P: The student will accurately solve word problems involving decimals	
1. Discuss with the students the various types of problems which might require the use of adding, subtracting, multiplying, and dividing decimals. Give an example of a discount problem--in order to see how much you pay for an item on sale.	
For example: A construction worker's necessary tools usually cost approximately $375.50, but they are on sale for 25% off (or .25). How would you find the cost of the tools? How much would the tools cost?	
You may want to ask "How would you find the number needed" until you are sure the student has the method of solving the problem clear in his/her head.	
2. Using a newspaper, solve the saving on groceries, clothes and other items--using decimals to figure them.	Newspapers

Worksheet G5

6.2	-	4.1	=	
-	☒	-	☒	-
5.3	-		+	1.4
=	☒	=	☒	=
	-	0.2	=	0.7

8.180	-		=	4.320
-	☒	-	☒	-
5.560	-		=	
=	☒	=	☒	=
	-	0.79	=	

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INSTRUCTIONAL MODULE

VOCATIONAL AREA:

Machinist
Carpentry
Air Conditioning and Refrigeration
Auto Mechanics
Welding
Auto Body

ACCESS SKILL: PERFORM BASIC OPERATIONS USING FRACTIONS

TASK ANALYSIS STEPS: A-U

ACTIVITY	MATERIALS/RESOURCES

NOTICE FOR MODULE INSTRUCTION

This module is intended to be used in conjunction with one or more math books. Several references and resources are listed in the bibliography which provide additional practice pages. It is not the intent of this module to provide practice pages, but to provide activities which help teach fractions as well as vocational application prototype problems which will give students a better understanding of the general trade and industry areas.

PRETEST INSTRUCTION

The three-part pretest is located at the end of the task analysis and instructional activity portion. The pretest may be used for both pre and post testing. It may be given at one sitting, or broken down into sections. Part 1 is theory and expressing fractions in simplest terms. Part 2 is actual problems. Part 3 is application problems.

Pretest
Part 1
Part 2
Part 3
Answer Sheet

TASK A: Student will define the term "fraction", and give an example of one from his/her daily life

---

1. Discuss with the student how we use the term fraction in daily conversation. For example: "He won the race by a fraction of a second. The door she cut was a fraction of an inch too short."

   In math we define a fraction as a PART OF A UNIT.

   Follow-up: Fractions are used often in daily living situations. Talk to your student about what 1/3 cup means when you're making a cake; about 1/2 of a can of oil when you're changing the oil in the car; 1/4 inch when you are measuring something.

Graph paper, pencil

2. ACTIVITY: Group students in pairs. Have them cut 4 pieces of graph paper 12 x 12.
   a. Cut one region into 2 parts. Are they the same size? Label each 1/2.
   b. Cut one region into 3 equal parts. Label each 1/3.
   c. Cut one region into 4 equal parts. Label each 1/4.
   d. Cut one region into 6 equal parts. Label each 1/6.
   e. Ask questions such as "Which is smaller 1/2 or 1/4?" "1/3 or 1/6?" "Which is the largest?" "Which is the smallest?"

Graph paper,
See also Modern Curriculum Press for dittoes on fractions

3. ALTERNATIVE: Use the same procedure with circular regions or shading diagrams.

4. Use a number line to show relative sizes. Ask the same kinds of questions.

ACTIVITY | MATERIALS/RESOURCES

TASK B: Student will define in his/her own words numerator and denominator and identify same in 3 out of 4 examples

1. DISCUSSION: A pie has been divided into 4 equal parts and you have eaten 3 pieces. You have eaten 3/4 of the pie. (Show in a diagram or with a flannel-board).

2. In any fraction, the denominator tells how many parts are represented. The numerator tells into how many parts the original was divided.

3. Using the graph paper cutouts from Task A, have the students divide into pairs and have each student hold up the 1/2 and tell his/her partner what the 1 and the 2 in 1/2 mean. Have them do the same for 1/3 and 1/6.

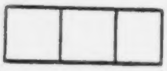
4. Give the students a sheet with the following and similar problems:

Shade the following:

a. You cut 1/2 of this board.
What is the numerator?_____

b. You used 1/6 of this pipe.
What is the denominator?_____

c. You need 1/8 of a piece of copper tubing.



d. The wall will be 1/3 blue.
What are the denominators?_____ _____

Follow-up: Examples such as these abound in the home and help the student understand the usefulness of fractions. Have student help cut and measure boards, pipes, tubing or cook with a recipe.

5. Have students work problems on the practice sheet. Some they can do alone, some together, and some as a class. — Worksheet B5

TASK C: Student will be able to express a set of items in fractional terms

1. Use concrete examples to get students to think in fractional terms, such as: There are 6 people in our class. 3 are boys. What fraction of our class are boys? (3/6) There are 6 people in our class. 5 have black hair. What fraction of our class has black hair? (5/6)

Follow-up: In class try to get the student to respond to common questions by using fractional terms. Ask parents to do the same if they wish. For example: I mowed ____ of the grass (instead of part of it). I did ____ of the dishes (instead of some of them). I took out ____ of the garbage. I have ____ left to take out.

2. Vocational examples: (May be done orally or written)

6 tools in all
2 are pliers
___of the tools are pliers

9 tools in all
3 are wrenches
___of the tools are wrenches

4 6-penny nails
25 nails in all
___of the nails are 6-penny nails

4 trucks
100 vehicles
___of the vehicles are trucks

ACTIVITY | MATERIALS/RESOURCES

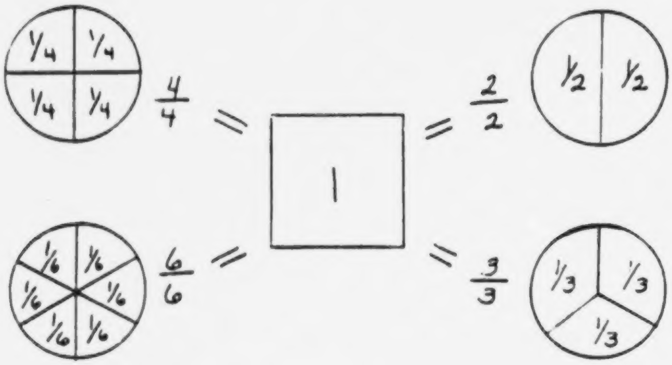
TASK C: CONTINUED

17 questions right	3 questions wrong
20 questions	20 questions right
___of the questions are right	___of the questions are wrong

TASK D: Student will generate fractions equal to one whole

1. DISCUSSION: Elicit from the student what constitutes a whole. Discuss whole pies (before a piece is missing), whole boards (before an end has been cut off), whole cans of oil (before some has been poured out). Have the students generate that something is whole before a portion has been removed.

   Put the diagram on the board, flannel-board or overhead. Use it to help students understand that when the same number is in the numerator and denominator, the fraction is equal to one whole. Have the students add to the diagram.



2. Construct varying kinds of problems to give students practice using fractions:

   A carpenter needs to find which of these fractions are equal to 1: 100/100, 15/20, 7/8, 18/18, 53/53

   An electrician wants to find out which of these fractions are equal to 4/4: 4/5, 8/8, 11/11, 1/3

   An auto mechanic needs to find out which fractions are equal to 15/15: 1/1, 1/6, 8/5, 3/4

ACTIVITY	MATERIALS/RESOURCES

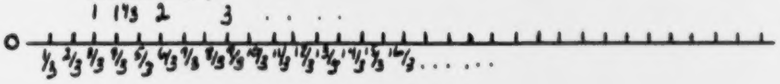
TASK E: Student will identify fractions greater than 1 (mixed numbers)

1. Introduce mixed numbers with examples that students are familiar with. For example: If you have 5 quarters to go downtown, how much do you have in dollars? (1 dollar, 1 quarter = 1 25/100) If you have 12 dimes and want to play video games that cost a dollar, do you have enough?

   Encourage students to discover a mixed number is a whole number and a fraction.

   Follow-up: The most common places to see mixed numbers are in the kitchen and garage. Doubling or reducing recipes, using different measuring cups than those that are called for will give students practice using mixed numbers.

2. Use the number line to show mixed numbers. (Students brainstorm).



   Have students make groups of 2 or 3. Have each make a number line using a different unit. (1/3, 1/4, 1/8, 1/16) Have them compare number lines. Which has the most units between whole numbers? Which has the least? Have them use the number lines to solve the vocational problems.

   An electrician needs to cut a wire 1 5/8". But his ruler is calibrated in 16ths of an inch. How many 16ths would it be? ______ (2 steps--do it together)

   A carpenter is cutting a joist that is 3 5/8" thick. How many 16ths inch are in 5/8"? ________________

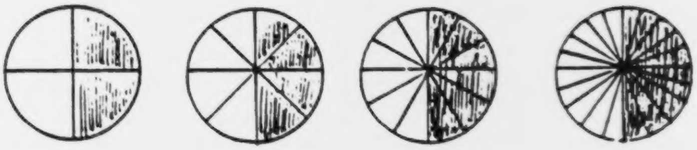
   A car mechanic is using a bolt 1" in diameter. How many 1/4 inches is it? ________________

TASK F: Student will generate equivalent fractions

1. Have a student pick a fraction (such as 1/3). Have other students multiply the numerator and denominator by various numbers. Draw out the new fraction and lead the students to understand that the value of the fraction has not changed, just the name.

   For example: 1/2

   Pick 2 2/4 | Pick 4 4/8 | Pick 6 6/12 | Pick 10 10/20



2. Using the same procedure, have the students find 6 fractions equal to 2/3, five fractions equal to 1/4, etc.

ACTIVITY | MATERIALS/RESOURCES

TASK F: CONTINUED

3. DISCUSS: Equivalent fractions are different names for the same quantities. You can multiply both terms of a fraction by the same number and not change the value.

   Follow-up: Measuring with a ruler offers lots of practice making equivalent fractions. For example:
   1/2" = _______1/4"

4. Have students work in twos and cut out the 8 x 1 cardboard model (Worksheet D1). By working together they need to complete these sentences:

   Worksheet D1

   1/2 = ___/4 1/4 = ___/8 1 = ___/4

   1 = ___/8 1/2 = ___/8 1 = ___/2

5. Give students vocational problems such as:

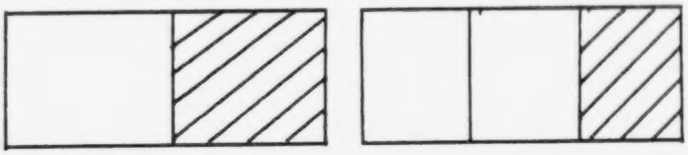
   A carpenter wanted to cut 3/8" off a board. How many 16ths inch would that be?

   How many 1/16 inch are there in a 5/8" diameter bolt?

TASK G: Student will compare fractions using > (greater than), < (less than), and = (equal to)

1. INTRODUCE: Use rectangles of equal size. Ask students to shade 1/2 in one and 1/3 in the other. Discuss which is the largest. Do the same comparing 1/4 to 1/3, 2/3 to 3/4, 1/3 to 5/6, and 2/3 to 1/2.

   For example:



2. REVIEW the concepts of greater than, less than and equal. REMIND students that the arrow always points to the smaller number. Do more shading problems similar to those in activity 1, but use the signs <, >, and =.

   For example: 1/2 > 1/3, 1/3 < 1/2

3. Have students use the units that they cut on Task A. Have them generate their own inequality problems, trade with a friend and work them. They then must check their friend.

   Follow-up: Continue to involve students in activities which emphasize fractions. Activities which emphasize use of different size wrenches or screwdrivers are good to show students that some tasks need varying sizes. For example: Socket wrenches are calibrated in varying sizes, as are bits for drills. Have students see the sizes of the drills or bits as they say the different sizes. 5/8" bit is less than 1/2" bit, etc

ACTIVITY

MATERIALS/RESOURCES

TASK G: CONTINUED

4. Give students vocational problems similar to these:

   a. Which socket is larger, 1/2 or 5/16? (use number lines, or pictures) (1/2)
   b. Which nut is smaller, 5/8 or 1/2? (1/2)
   c. Which hose is larger, 2 3/8 or 2 5/16? (2 3/8)
   d. Which garden is larger, the one that is 5 by 7 1/4 feet or the one that is 5 by 7 1/3 feet? (5' x 7 1/3')
   e. Which cup holds less, the 3/4 cup or the 1/2 cup? (1/2 cup)
   f. Which of the following wires is smaller than 1/2"?
      1/4" 2/3" 1/5" 2/2"

TASK H: Student will use the terms prime number and composite number correctly when working factor trees

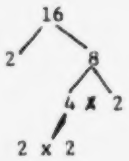
NOTE
For most students this should be a review. They should have had experience with factoring earlier. If they haven't, the teacher will need to do more reinforcement and instruction.

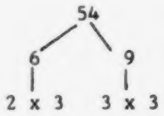
1. REVIEW: Prime number--can't be divided by any number except one and itself to yield a whole number.

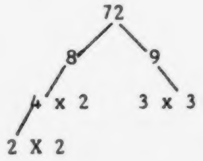
   Composite number-may be divided by a number other than itself and one.

   For example: 22 = 11 x 2 (these are prime numbers)
   18 = 6 x 3 (6 can be divided by 3 and 2--it is composite)
   (3 can only be divided by itself--it is prime)

   Give some examples of factor trees. (Student is to supply handwritten answers.)







   (Putting in X sign helps.)

2. Give students lots of board examples and seat examples on finding the common factor. For example: Name the common factor for these:

   4/12 ____ 6/9 ____ 5/15 ____

   3/6 ____ 6/54____ 7/21 ____

   This is the most difficult aspect for many students to understand. It needs lots of time and reinforcement. (See drill page)

Worksheet H2

ACTIVITY	MATERIALS/RESOURCES

TASK I: Student will express fractions in their simplest form

1. To introduce the simplest form of a fraction, have students make chains as they did in task F. Brainstorm which is the simplest form (use lowest terms if necessary). For example:

1/2	2/4	4/8	8/16	16/32
2/5	6//15	8/20	10/25	12/30

2. Tell students just as they could multiply a fraction and not change the value, they can divide each term by the same number and not change the value.

For example: $\frac{4 \div 4}{8 \div 4} = \frac{1}{2}$ or $\frac{3 \div 3}{18 \div 3} = \frac{1}{6}$

3. Set up charts as the following to help students express fractions in simplest form:

FRACTION	8/12	5/15	8/32
Factors in numerator	1,2,4,8		
Factors in denominator (Circle common factors)	1,12,3,4 6,2		
Greatest common factor	4		
Divide by	4		
Simplest form	8 - 4 = 2 12 - 4 = 3		

4. Do vocational application problems such as the ones on Worksheet I4.

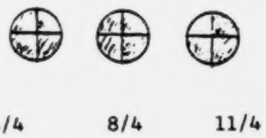
Worksheet I4

TASK J: Student will express improper fractions as mixed numbers

1. REVIEW division showing remainders as fractions. For example:

$$\begin{array}{r} 6 \\ 13\overline{)84} \\ \underline{78} \\ 6 \end{array} = 6\ 6/13$$

2. Use diagrams, or a number line (made in Task E) to show students the relationship between improper fractions and mixed numbers. For example:

11/4 = 

= 2 wholes and 3/4

Have the students draw out and shade in:

13/5 21/6 17/7

ACTIVITY	MATERIALS/RESOURCES

TASK J: CONTINUED

3. INSTRUCTION: When we want to rename fractions greater than a whole number, we just divide the numerator by the denominator. For example:

$$11/4 = \overset{2\ 3/4}{4\overline{)\,11}}$$

$$13/5 = \overset{2\ 3/5}{5\overline{)\,13}}$$

NOTE: Some students have trouble knowing when to divide. They may need more practice on identifying improper fractions. They may grasp the idea better if you talk in terms of the fraction being TOP HEAVY -- that is the top number (numerator) is larger than the bottom (denominator). They may need further practice in locating and identifying improper fractions.

Follow-up: A concrete way to understand improper fractions is through using measuring cups. If a recipe calls for 2 1/2 cups flour, have the student measure all the flour with the half-cup. This will allow him/her to discover that 2 1/2 does equal 5/2. The same procedure can be done with varying sizes. The same kind of activity can be done measuring. Have a student measure a surface using just 1/2 inches and see if he can get the same answer after simplifying as he got with whole inches.

4. Give the student vocational practice problems such as:

   a. A cook put in 11 quarter cups of flour. How many whole cups and what fractional part did she put it?______(2 3/4)
   b. A brace that a builder uses measures 7 inches. What part of a foot is that? ____(7/12). What part of a yard is that? (Hint: A yard is 36 inches.) _____(7/36)
   c. A painter worked 7 half hours painting a house. How many whole and half hours did he work? ____(3 1/2)
   d. An electrician needed a wire that was 67/4 inches long. How long was the wire?_____(16 3/4)
   e. Jerry is making some shelves. Each shelf is to be (13/2) feet long. How long is each shelf in whole feet?____ (6 1/2)
   f. A mechanic worked 18/4 hours on a manifold. How many whole hours did he work?____(4) What fractional hour did he work?_____(1/2)

TASK K: Student will successfully multiply fractions

1. INTRODUCE multiplying fractions to students by using the following examples:

   If I have 3 quarters, what part of a dollar do I have?
   3/1 x 1/4 = 3/4
   If I have worked 4 half-hour periods, how long have I worked?
   4/1 x 1/2 = 4/2 = 2 hours
   If I have 1/5 of a 5/8 ft. board, how much do I have?
   1/5 x 5/8 = 5/40

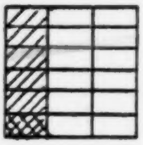
   In each case have students tell you why you multiply (that it is the same as successive addition).

ACTIVITY	MATERIALS/RESOURCES

TASK K: CONTINUED

2. To help students understand that multiplying fractions may give you a smaller amount, have them draw out some examples.

For example:
1/3 x 1/6
Make 1/3 ////
Make 1/6 \\\\ on the other axis



Draw out 1/2 x 1/3
2/5 x 1/4
1/6 x 2/3

3. You may need to use flannelboard cutouts or pie graphs to go over this with some students who have difficulty.

4. Vocational problems can be developed such as these:

(Be sure and simplify your answers.)

a. Mr. Jones is a chef. He had 3/4 dozen eggs and he used 1/2 of them. How many did he use?____ (3/8)

b. Ms. Smith is an electrician. She had 1/2 ft of copper wire and used 5/8 of it. How much did she use?____ (5/16)

c. Mr. Maniford is an auto repairman. He had 3/4 foot of tubing and used 1/3 of it repairing a hose. How much did he use?____ (3/12 = 1/4)

d. If Mrs. Bransford used 1/2 of the 7/8 foot board for a rod, how much was used?____ (7/16)

e. A painter had 1/2 of a can of blue paint. He used 1/3 of it painting a cupboard. How much was used?____(1/6)

5. After many pages of practice with multiplying, CANCELLING may be introduced. (A term that will cause less confusion is dividing before we mutliply).

INSTRUCT the student that we divide before we multiply by the common factor (covered in Task H).

For example: 2/4 x 6/8 = $\frac{\overset{1}{\cancel{2}}}{\underset{2}{\cancel{4}}} \times \frac{\overset{3}{\cancel{6}}}{\underset{4}{\cancel{8}}}$ May help to use colored pencils or colored chalk to show students that we work with numbers diagonally across. Also it might be advisable to let students do the cancellation problems on graph paper, so that each number can be lined up diagonally.

TASK L: Student will successfully multiply mixed numbers

1. INTRODUCE: Have students practice changing mixed numbers into improper fractions. (This is the reverse of what they did in Task I).

For example: 3 1/2 = (Think 3 x 2 + 1 = $\frac{7}{2}$)

ACTIVITY	MATERIALS/RESOURCES

TASK L: CONTINUED

It may help to draw arrows in colored pencil to help students see and remember that they are to multiply.

For example: $\underset{\curvearrowleft}{\overset{\times\,\curvearrowright}{3 \times \frac{1}{2}}} = \frac{7}{2}$ or $\underset{\curvearrowright}{\overset{\curvearrowright}{3 \times \frac{1}{2}}}^{+1} =$

Follow-up: Suggest to parents that student could do the following at home or have student do in class:

Have the student figure area of rooms in the house. (These usually include fractions.)

Have the student take an active part in constructing something that involves measuring, or plotting out a garden.

Have the student increase or decrease a recipe that involves mixed numbers.

Have the student calculate his/her own allowance, based on a set rate per hour.

Have the student double-check bills that involve fractions, such as light bill.

2. After students are comfortable changing a mixed number to an improper fraction, tell them that to multiply mixed numbers, we first change them into improper fractions and then multiply.

For example: $3\ 1/2 \times 4\ 1/4 = \frac{7}{2} \times \frac{17}{4} = \frac{119}{8} = 14\frac{7}{8}$

3. Give the students many experiences multiplying mixed numbers, including vocational problems like these:

A carpenter was to figure these areas. Help him multiply.

Shelf 2 1/2 feet by 7 3/4 feet = 19 3/8

$5/2 \times 31/4 = 155/8$

Window 3 1/3 feet by 2 1/2 feet = 8 1/3

$\overset{5}{\cancel{10}}/3 \times 5/\underset{1}{\cancel{2}} = 25/3$

Tile 11 1/2 inch by 8 1/4 inch = 94 7/8

$23/2 \times 33/4 = 759/8$

Cabinet 15 1/4 feet by 3 1/5 feet = 323 3/10

$61/4 \times 16/5 = 6466/20$

4. REVIEW expressing a whole number as a fraction, by using 1 as the denominator.

For example: 6 = 6/1, 100 = 100/1, 5000 = 5000/1

5. Go over multiplying mixed numbers with the student. Whole numbers are the same.

ACTIVITY	MATERIALS/RESOURCES

TASK M: Student will successfully divide fractions

1. Have the students multiply the following:

4/5 x 5/4 =	2/3 x 3/2 =
1/3 x 1/6 =	4/9 x 9/4 =
1/7 x 7/1 =	8/7 x 7/8 =

Have the students circle all those answers that are equal to one. Ask them "What do you notice about the terms of the fractions that are equal to 1?" (They should say, when multiplied they are turned upside down.) Say "Yes, two fractions that equal 1 are called reciprocals."

2. Give the students practice problems fading out information.

For example: 2/3 - 4/7 = 2/3 x 7/____ =
5/4 - 2/6 = 5/____x $\overline{6/2}$ =

TASK N: Student will successfully divide mixed numbers

1. REVEIW process of multiplying mixed numbers (See Task L).

2. Use division process, but rename mixed numbers as fractions first.

For example: A carpenter needs 2 1/2' lengths of board. How many will she get from a board 6 1/3 long?

6 1/3 - 2 1/2 = $\frac{19}{3} - \frac{5}{2}$ (Change to improper fraction)

= $\frac{19}{3}$ x (Change sign)

= $\frac{19}{3} \times \frac{2}{5}$ (Reciprocal)

= $\frac{19}{3} \times \frac{2}{5}$ = (Multiply)

= $\frac{38}{15}$ (Simplify)

= 2 8/15

3. Vocational application:

This recipe serves 8 but only 4 will come to dinner. Write the new amounts.

MEATLOAF SUPREME

2 1/2 lb. hamburger
2 c. cracker crumbs
3 1/2 T. Worchestershire sauce
3 eggs
3/4 c. onion
2 t. salt
2 1/4 c. catsup

TASK O: Student will successfully add like fractions

1. Have the students manipulate various concrete materials to get the idea of addition of fractions.

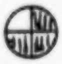
ACTIVITY

MATERIALS/RESOURCES

TASK O: CONTINUED

For example:

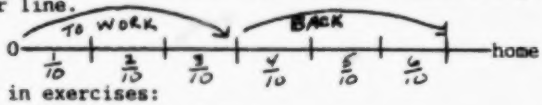
a. The recipe said to use 1/4 apple in the topping and 2/4 apple in the filling. How much apple was used? Use a real apple or a picture.



topping

filling

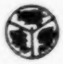
b. John walked 3/10 miles to work at an electrical plant and 3/10 miles back. Show how far he walked using a number line.



c. Shade in exercises:

Shade in 1/4 + 1/4 2/4 = 1/2

Shade in 2/3 + 1/3 3/3 = 1



2. Help the student to deduce, one may express addition as numerators over the same denominator.

For example: 2/3 + 1/3 = 2 + 1/3 or $\frac{2 + 1}{3}$

3. Give students application problems like these:

a. A cook used 1/4 tsp. ginger and 3/4 tsp. cloves. How much spice did she use? (1 tsp.)

b. A builder used 5/8 box of nails on the cupboards and 2/8 box on the kitchen windows. How many were used? (7/8)

c. A mechanic works 4 1/4 hour on one car, 3 3/4 hours on another and 2 1/4 hour on a third. What is the total number of hours worked? (10 1/4)

Follow-up: Give students opportunities to add fractions at home:
Add up the number of hours they have worked on a chore or project.
Add up the number of hours they watch TV in on week.
Add up the number of hours they work on homework.

Discuss the above calculations!

Have students initiate or help with building of a project. This will involve measuring and addition of fractions. (Even putting together a model involves some work with fractions.)

TASK P: Student will successfully subtract like fractions

1. Give the students a variety of problems to do including the following:

a. An electrician had 3/4 inch wire and used 1/4 inch of it. How much was left? (1/2)

b. A cook had 7/8 cup broccoli and used 3/8 cup in a recipe. How much was left? (4/8 = 1/2)

c. A painter had 5/6 gallon of paint left and he used 4/6 gallon to paint a closet. How much was left? (1/6)

ACTIVITY	MATERIALS/RESOURCES

TASK P: CONTINUED

d. A mechanic used 3/8 can of motor oil yesterday and 1/8 can today. How much is left in the can? (1/4)

Follow-up: Send these suggestions to parents if possible.

Continue to provide concrete experiences for the student to work with fractions.

For example: If you use 3/8 box of cereal, in muffins and John eats 1/8 for breakfast, how much cereal is left?

Construct subtraction problems that are necessary in whatever area the student is interested. Some areas might be: cooking, sewing, building, gardening, mechanics, etc.

(Cooking) If we use 1/3 box raisins in cookies, how much is left?

(Sewing) If the seam allowance is 5/8 inch, how much space will be between the seam and the inch line?

(Building) If you work on shelves 2/5 hour today, how much time will be left?

(Gardening) If we plant 1/6 of the turnip seeds today and 3/6 tomorrow, what will be left?

(Mechanics) You are making an axle shaft key 1/4 inch square. But you find a key 1/4 inch by 2/4 inch. How much stock do you have to remove?

TASK Q: Student will successfully add and subtract unlike fractions

1. REVIEW multiples. Multiples are multiplying a number times 1, 2, 3, 4, 5, 6, 7, etc. The least common multiple is the smallest multiple of 2 numbers.

   For example: 4: 4, 8, 12, 16, 20, 24
   5: 5, 10, 15, 20

   Have students find the least common multiple of many different numbers, including:

   6 4

   9 3

2. Instructions: Have the student block out the numerator of the fraction and concentrate on the denominator. (He can use his finger, paper, pencil, etc.)

   Have him look at the two denominators and generate the common multiples. Then circle the least common multiple.

   For example: 1/4 = 4, 8, 12, 16, 20, 24
   +2/5 = 5, 10, 15, 20

TASK Q: CONTINUED

3. The least common multiple becomes the least common denominator when working with fractions. Have students practice finding the LCD on fraction like these.

$\frac{y}{6} + \frac{z}{3}$ _____ $\frac{m}{3} + \frac{n}{10}$ _____

$\frac{a}{7} + \frac{b}{5}$ _____ $\frac{c}{7} + \frac{d}{4}$ _____

NOTE

For some students it will be necessary to separate addition and subtraction. The processes are very similar, so are treated as one step.

4. REVIEW equivalent fractions (Task F). Do this to help students prepare to multiply both terms of a fraction.

5. Instruction:

Step 1 - Cover the numerator--look only at the denominator

	Find LCD	Rename to make equal fractions	Add or Subtract
$\frac{2}{3}$	$\frac{\_}{6}$	2 x 2 = 4 3 x 2 = 6	$\frac{4}{6}$
$\frac{1}{+6}$	$\frac{\_}{6}$	1 x 1 = 1 6 x 1 = 6	$\frac{1}{+6}$
			$\frac{5}{6}$

If a student has great difficulty--have her multiply the denominators to find a common denominator.

6. Give students practice problems with at least 2 common denominators.

For example:

$\frac{2}{6} \times \_ = \frac{\_}{30}$ $\frac{1}{4} \times \_ = \frac{\_}{12}$ $\frac{5}{12} \times \_ = \frac{\_}{12}$

$\frac{1}{+5} \times \_ = \frac{\_}{30}$ $\frac{3}{+6} \times \_ = \frac{\_}{12}$ $\frac{1}{-3} \times \_ = \frac{\_}{12}$

____ ____ ____ ____ ____ ____

7. Vocational application problems:

   a. In a car the cross member is 1/8" and the frame is 2/3" thick. How deep should the hole be to go through both pieces?

ACTIVITY | **MATERIALS/RESOURCES**

TASK Q: CONTINUED

$$\begin{array}{rcr} \frac{1}{8} & & \frac{3}{24} \\ +\frac{2}{3} & + & \frac{16}{24} \\ \hline & & \frac{19}{24} \text{ inch} \end{array}$$

b. An electrician has 1/8' wire. He used 2/3' for a hookup. How much is left? (5/24')

c. A carpenter works 2/3 hour hammering, 1/4 hour drilling and 1/2 hour sanding. How many hours did he work?

$$\begin{array}{rr} \frac{2}{3} & \frac{8}{12} \\ \frac{1}{2} & \frac{6}{12} \\ +\frac{1}{4} & +\frac{3}{12} \\ \hline & \frac{17}{12} = 1\frac{5}{12} \text{ hours} \end{array}$$

TASK R: Student will successfully add and subtract mixed numbers with the same denominator

1. REVIEW adding and subtracting fractions with common denominators (Task O and P).

2. Caution students to first add or subtract fraction, then the whole number.

   For example:

$$\begin{array}{rrr} 2\frac{1}{5} & \frac{1}{5} & 2 \\ +\,1\frac{2}{5} & +\frac{2}{5} & +1 \\ \hline & \frac{3}{5} & 3 = 3\frac{3}{5} \end{array}$$

3. Give students vocational problems including:

   a. A plumber needs pipes these lengths: 15 3/16, 5 5/16, 3 2/16. How much pipe does she need?

   b. An electrician has one wire 15 1/3' long and another 17 2/3'. How much longer is the second wire?

ACTIVITY	MATERIALS/RESOURCES

TASK S: Student will add and subtract mixed numbers with different denominators

1. REVIEW finding a common denominator.
2. Instruction: Use 4-step method.

Find Least Common Denominator	Write Whole Numbers--Rename Fraction	Find Numerator	Add or Subtract
$2\frac{1}{3}$ $\frac{\quad}{3}$	$2\frac{\quad}{6}$	$2\frac{2}{6}$	$2\frac{2}{6}$
$+3\frac{1}{2}$ $\frac{\quad}{2}$	$3\frac{\quad}{6}$	$3\frac{3}{6}$	$+3\frac{3}{6}$
			$5\frac{5}{6}$

If student has difficulty--draw out process--or go back to adding and subtracting fractions.

3. Give a number of practice problems.

$$\begin{array}{r}5\frac{1}{2}\\ -3\frac{2}{3}\\ \hline\end{array}\qquad\qquad\begin{array}{r}6\frac{1}{7}\\ +4\frac{1}{5}\\ \hline\end{array}\qquad\qquad\begin{array}{r}2\frac{5}{8}\\ +1\frac{1}{3}\\ \hline\end{array}$$

TASK T: Student will add and subtract a mixed number from a whole number.

1. NOTE: Students often have difficulty subtracting a mixed number from a whole number because they forget to rename.
2. Have students find problems in which they will need to rename on a worksheet and circle them in red. Then work them.

Follow-up: Have students add number of hours they work babysitting, or doing lawn work and total weekly. For example: "I babysat 3 hr. Monday, 1/2 hr. Tuesday, 4 1/2 hr. Friday = 8 hr." Students can keep a record of their hours and earnings.

3. For example:

For example:	Rename	Equivalent Fraction
3	2 + 1	$2\frac{4}{4}$
$-1\frac{1}{4}$		$-1\frac{1}{4}$
		$1\frac{3}{4}$

Follow-up: Ask students to keep track of amounts they use. For example: Amount of oil in the car. (6 cans or 5 1/3 cans)

4. Vocational application:

   a. A carpenter has boards 6', 5 3/4' and 7 2/3'. How much do they total? ________

ACTIVITY	MATERIALS/RESOURCES

TASK T: CONTINUED

b. An auto mechanic has 15 cans of oil. He uses 6 2/5 cans in the morning. How much is left to use? ________

TASK U: Student will subtract mixed numbers where he/she must rename two times

1. REVIEW renaming to make a common denominator (Task S).
   REVIEW renaming whole numbers to improper fractions.

2. Go over many examples with the student.

	Common Denominator		Rename Whole Number	Subtract
5 1/4	2/8	Can't	4 + 8/8 + 2/8	4 10/8
-3 1/3		subtract		-3 3/8
	3/8	so	3 3/8	1 7/8

3. Use colored pencils to show graphically the renaming.

6 1/5	3/15	5 + 15/15 + 3/15	= 5 18/15
-3 1/3	5/15		-3 5/15
			2 13/15

Graph paper also helps keep numbers aligned properly. — Graph paper

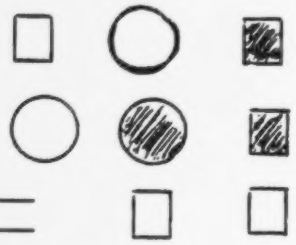
4. Do vocational application problems. — Worksheet U4

*This is a difficult concept and may take extra time and/or reinforcement.

PRE-TEST 1
Theory and Fraction Expression

Related Task

(c) 1. a. There are _____ figures in this group.
b. _____ of the _____ are circles.
c. _____ of the _____ are squares.
d. What fraction is circles? _____
e. What fraction is squares? _____
f. What fraction of the squares are shaded? _____
g. What fraction of the circles are shaded? _____



(B) 2. 8 is the denominator and 3 is the numerator, what is the fraction? _____

(A) 3. Define what a fraction is in your own words.

(A) 4. Give one example of a fractional set in our room. (For example, there are 5 windows and 2 are open. 2/5 of the windows are open.)

(D) 5. Circle the fractions equal to one.

$\frac{6}{6}$ $\frac{3}{5}$ $\frac{15}{15}$ $\frac{100}{100}$ $\frac{17}{15}$ $\frac{25}{25}$

(F) 6. Find 5 fractions equal to 1/3. Find 5 fractions equal to 1/4.

$\frac{1}{3} = \frac{\_\_}{6} = \quad = \quad = \quad = \qquad \frac{1}{4} = \quad = \quad = \quad = \quad =$

(G) 7. Use the signs <,>, and = to compare these fractions.

1/4 ____ 1/3 1/6 ____ 1/8 2/5 ____ 2/8

3/8 ____ 5/6 2/3 ____ 3/4 1/16 ____ 2/32

(H) 8. Find the prime factors of the following numbers.

56 48 81

(I) 9. Express the following fractions in their simplest form.

8/10 = ____ 15/20 = ____ 7/21 = ____

4/6 = ____ 16/24 = ____ 7/49 = ____

(J) 10. Express the following improper fractions as mixed numbers.

15/10 = ____ 26/3 = ____ 45/5 = ____

8/8 = ____ 17/4 = ____ 81/9 = ____

PRE-TEST 2
Actual Problems

(K,L) 11. Multiply and express in simplest form.

$$\frac{3}{4} \times \frac{1}{5} = \qquad \frac{5}{9} \times \frac{3}{4} = \qquad \frac{1}{2} \times \frac{1}{2} =$$

$$1\frac{2}{3} \times \frac{1}{4} = \qquad 2\frac{1}{2} \times 3\frac{1}{4} = \qquad \frac{3}{4} \times 2\frac{5}{8} =$$

(M,N) 12. Divide and express in simplest form.

$$\frac{3}{8} \div \frac{1}{4} = \qquad \frac{5}{6} \div \frac{5}{6} = \qquad \frac{4}{9} \div \frac{2}{3} =$$

$$2\frac{5}{8} \div \frac{1}{2} = \qquad 3\frac{1}{6} \div 2\frac{1}{7} = \qquad 3\frac{3}{4} \div \frac{2}{3} =$$

(O, Q, R, S) 13. Add and express in simplest form.

$$\begin{array}{rrrrr} 3\frac{1}{5} & 5\frac{5}{7} & 2\frac{5}{8} & 6 & \frac{4}{7} \\ \underline{+4\frac{2}{5}} & \underline{+3\frac{2}{7}} & \underline{+1\frac{1}{3}} & \underline{+2\frac{7}{8}} & \underline{+\frac{1}{3}} \end{array}$$

(P, Q, R, S, T, U) 14. Subtract and express in simplest form.

$$\begin{array}{rrrrr} \frac{5}{7} & \frac{1}{2} & \frac{3}{5} & 3\frac{1}{8} & 2\frac{1}{8} \\ \underline{-\frac{2}{7}} & \underline{-\frac{1}{4}} & \underline{-\frac{1}{5}} & \underline{-1} & \underline{-1\frac{5}{8}} \end{array}$$

$$\begin{array}{rrr} 3\frac{1}{6} & 5\frac{3}{8} & 6 \\ \underline{-1\frac{2}{3}} & \underline{-2\frac{3}{5}} & \underline{-2\frac{5}{8}} \end{array}$$

PRE-TEST 3
Application Problems

Letters in ( ) refer to Task Analysis Step.

(C) 1. 6 tools in all
2 are pliers
______ of the tools are pliers

(C) 2. 4 cars
50 vehicles
_____ of the vehicles are cars

(D) 3. An auto mechanic wants to find a fraction equal to 1. Is it 3/4, 2/3, or 16/16? _____

(F) 4. A carpenter is cutting a joist that is 3 5/8 in. thick. How many 16ths of an inch are in 5/8 inch?

(F) 5. How many 1/16 inch are there in a 1/2 inch diameter bolt?

(G) 6. Which socket is larger 1/2 or 5/16?

(J) 7. A cook put in 11 quarter cups of flour in a recipe. How many whole cups did he use?

(K) 8. Ms. Smith is an electrician. She has 1/2 ft. of copper wire and used 5/8 of it. How much did she use?

(L) 9. What is the area of a shelf 2 1/2 ft. by 7 3/4 ft?

(M) 10. A mechanic has a bolt 3/4 inch long. He needs to divide it in half. How long will each portion be?

(N) 11. A cook needs to divide a recipe in half. She has 6 3/4 lb. of hamburger. How much would be used in 1/2 of the recipe? (Careful: 6 3/4 - 2)

(O) 12. In her recipe the cook uses 1/4 tsp. ginger and 3/4 tsp. cloves. How much spice does she use all together?

(P) 13. A mechanic used 3/8 can of motor oil yesterday and 1/8 can today. How much is left in the can?

(Q) 14. An electrician has 7/8 ft. wire. He used 2/3 ft. for a hook-up. How much is left?

(R) 15. A plumber needs pipes these lengths: 15 3/16, 5 5/16, 3 2/16. How much pipe does he need?

(T) 16. A cook has 5 cans of peaches. He uses 3 1/2 in some pies. How much is left?

(U) 17. A gasoline tank contains 20 1/2 gallons of gas. The owner uses 9 2/3 gallons on a trip. How much gas is left?

ANSWER SHEET

PRE-TEST 1

1. a. 8
   b. 3,8
   c. 5,8
   d. 3/8
   e. 5/8
   f. 2/5
   g. 1/3

2. 3/8

3. A part of something

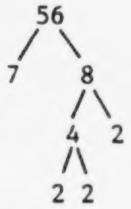
4. Accept reasonable answers

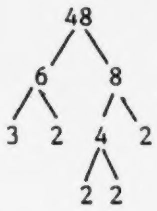
5. $\frac{6}{6}$ $\frac{15}{15}$ $\frac{100}{100}$ $\frac{25}{25}$

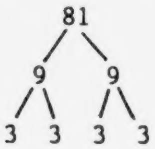
6. Check for equivalency

7. < > >
   < < =

8.







9. 8/10 = 4/5   15/20 = 3/4   7/21 = 1/3
   4/6 = 2/3   16/24 = 2/3   7/49 = 1/7

10. 1 1/2, 8 2/3, 9
    1, 4 1/4, 9

PRE-TEST 2

11. 3/20, 15/36 = 5/12, 1/4
    5/21, 8 1/8, 1 31/32

12. 1 1/2, 1, 2/3
    5 1/4, 1 43/90, 1 7/8

13. 7 3/5, 9, 3 23/24, 8 7/8, 19/21

14. 3/7, 1/4, 2/5, 2 1/8, 1/2, 1 1/2, 2 31/40, 3 3/8

PRE-TEST 3

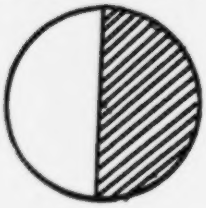
1. 2/6 = 1/3
2. 4/50 = 2/25
3. 16/16
4. 10/16
5. 8/16
6. 1/2
7. 2 3/4
8. 5/16
9. 19 3/8 sq. in.
10. 3/14
11. 3 3/8
12. 1 tsp.
13. 1/2
14. 5/24
15. 23 5/8
16. 1 1/2
17. 10 5/6

WORKSHEET B5

FRACTION PRACTICE

Name the fractional part shaded.

A CARPENTER SAWS OUT THE FOLLOWING:



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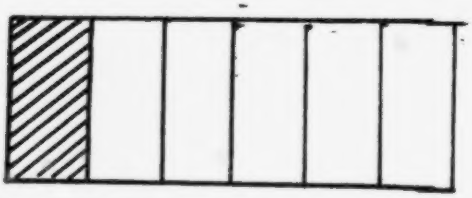

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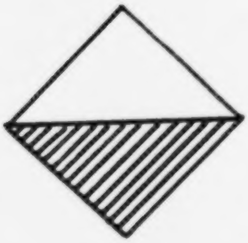

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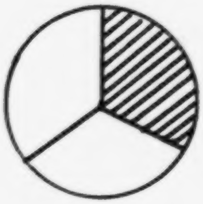
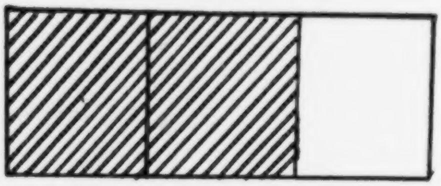
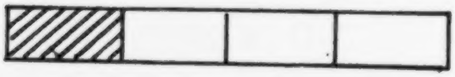


____

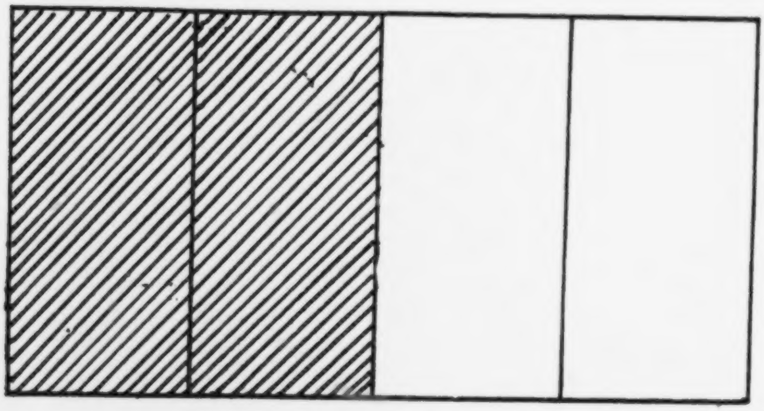
A BUILDER NEEDS TO KNOW HOW MUCH OF THE FOLLOWING HE/SHE NEEDS:
(Fill in the blank.)



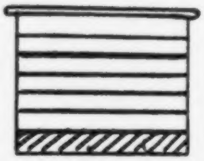
____________board



______________ copper tubing



________________room



_________ can of paint

WORKSHEET B5 Continued

1. The top number of a fraction is called a ____________________.

2. The bottom number of a fraction is called the ________________.

3. A fraction is a ______________ of a whole.

4. If you divide something into 6 parts, the numerator will be _____.

5. If you divide something into 3 parts, the numerator will be _____.

6. In the fraction 10/24, the unit has been divided into _____ parts and you have ______ of them.

7. Define what a fraction is in your own words.

8. Give one example of a fraction from daily life.

9. In the fraction 1/4, tell what each number means.

$$\frac{1 =}{4 =}$$

10. Express some set in this room in a fraction.

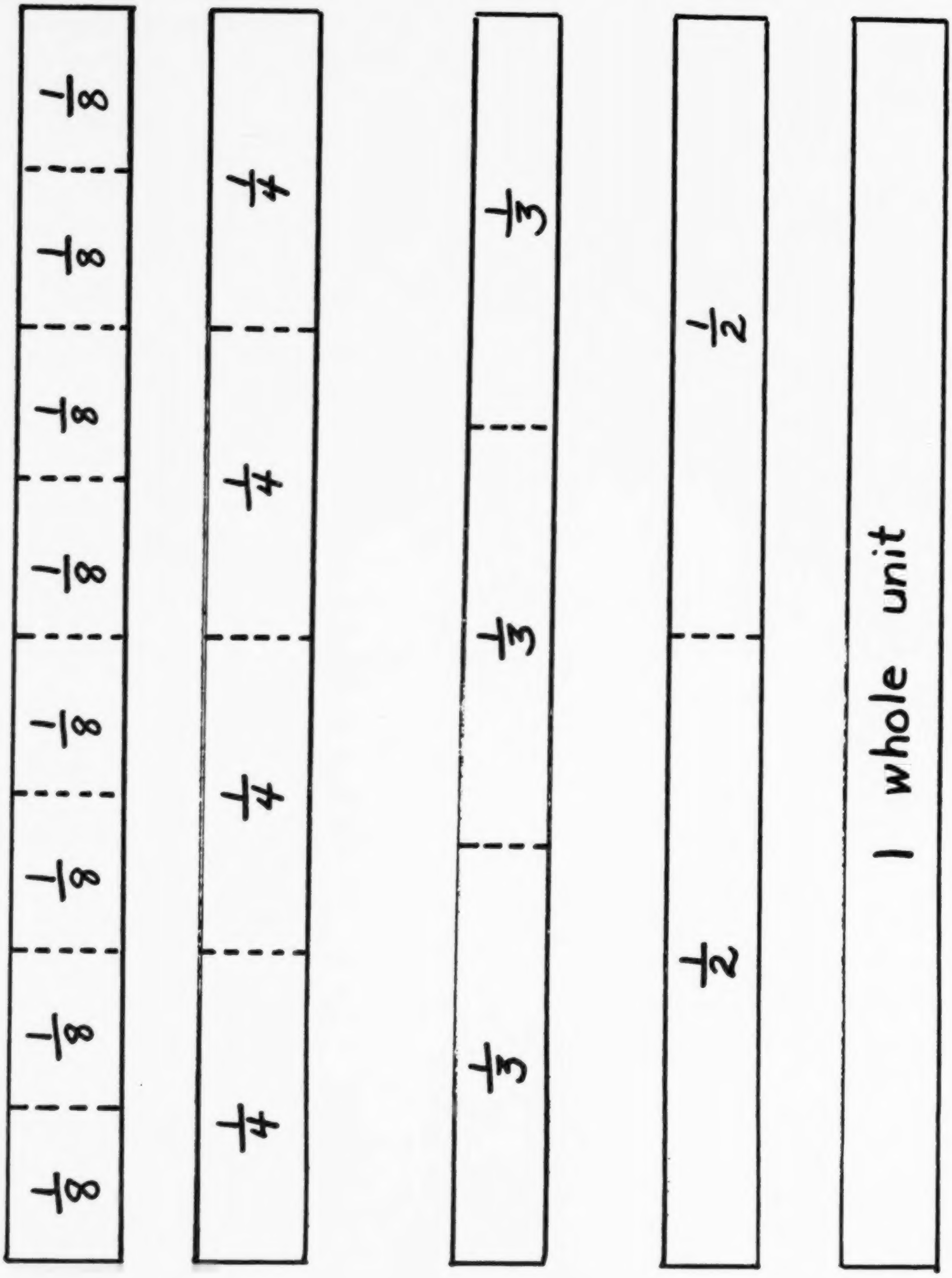
For example: There are 5 chairs and 3 are vacant. 3/5 of the chairs are vacant.

ANSWER KEY:

1. numerator
2. denominator
3. part
4. 6
5. 3
6. 24,10

7 - 10. Accept reasonable answers.

WORKSHEET D1


1 whole unit
$\frac{1}{2}$
$\frac{1}{2}$
$\frac{1}{3}$
$\frac{1}{3}$
$\frac{1}{3}$
$\frac{1}{4}$
$\frac{1}{4}$
$\frac{1}{4}$
$\frac{1}{4}$
$\frac{1}{8}$
$\frac{1}{8}$
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$\frac{1}{8}$
$\frac{1}{8}$
$\frac{1}{8}$
$\frac{1}{8}$
$\frac{1}{8}$

WORKSHEET H2

Make factor trees for the following:

6 12 9

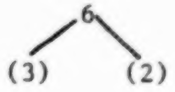
15 18 15

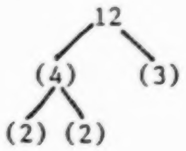
Find the factors for the numerator and denominator. Then find the common factors and the greatest common factor.

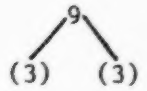
	FACTORS	COMMON FACTORS	GREATEST COMMON FACTOR
$\frac{15}{30}$	1, 15, 3, 5, 1, 30, 5, 6, 3, 10	1, 3, 5	5
$\frac{8}{24}$			
$\frac{12}{20}$			
$\frac{30}{45}$			
$\frac{21}{49}$			
$\frac{20}{28}$			

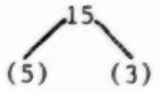
ANSWERS TO WORKSHEET H2

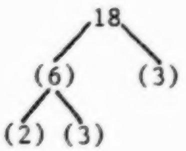
Make factor trees for the following.

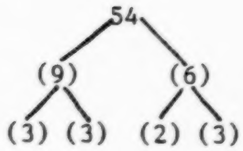












Find the factors for the numerator and denominator. Then find the common factors and the greatest common factor.

	FACTORS	COMMON FACTORS	GREATEST COMMON FACTOR
$\frac{15}{30}$	1, 15, 3, 5 1, 30, 5, 6, 3, 10	1, 3,	5
$\frac{8}{24}$	1, 8, 2, 4 1, 24, 4, 6, 12, 2	1, 2, 4	4
$\frac{12}{20}$	1, 12, 3, 4, 6, 2 1, 20, 10, 2, 4, 5	1, 2, 4	4
$\frac{30}{45}$	1, 30, 6, 5, 10, 3, 15, 2 1, 45, 5, 9	1, 5	5
$\frac{21}{49}$	1, 21, 7, 3 1, 49, 7	1, 7	7
$\frac{20}{28}$	1, 20, 5, 4, 10, 2 1, 28, 4, 7, 14, 2	1, 2, 4	4

WORKSHEET I4

PRACTICE PAGE FOR COMPARING FRACTIONS AND SIMPLEST TERMS

1. One piece of pipe is 1/2 inch, one is 5/8 inch. Which is bigger? (Hint: 1/2 = ?/8ths?)

2. One recipe call for 2/3 cups of flour. One calls for 4/6 cups of flour. Which is more? BE CAREFUL! __________

3. One bolt is 3/8 inch and one is 1/4 inch. Which is smaller? __________

4. One wire is 3/8 inch in diameter and one is 5/16 inch. Which is larger? __________

5. A carpenter has made the following calculations. He needs to find the simplest terms for his answers. Can you help him?

   Cut board 2 6/12 ft. = __________

   Cut pipe 5 4/12 ft. = __________

   Cut window 2 10/16 ft.= __________

6. An auto mechanic needs a wrench for a job that is 10/16 in. diameter, but her wrenches are calibrated in 1/8 inches. Which should he use?

7. How many 1/16 inches are there in a 3/4 inch piston pin?

8. What is the size of a socket 1/8 inch larger than 1/2 inch?

9. What is the size of a nut 1/4 inch smaller than 5/8 inch?

ANSWER KEY:

1. 5/8 inch
2. same
3. 1/4 inch
4. 3/8 inch
5. 2 1/2, 5 1/3, 2 5/8
6. 5/8 inch
7. 3/4 = 12/16
8. 1/2 = 4/8 + 1/8 = 5/8
9. 1/4 = 2/8   5/8 - 2/8 = 3/8

Worksheet U4

VOCATIONAL APPLICATION PROBLEMS

1. A gasoline tank contains 20 1/2 gallons of gas. The owner uses 9 2/3 gallons on a trip. How much gas is left? (10 5/6)

2. The following amounts are taken from a 5 gallon can of oil: 1/2 gal, 1 2/3 gallon, 2 1/3 gallon. How much is left? (1/2)

3. A mechanic needs 4 bolts that are 1/2" in diameter and 5/8" long. All she can find are 4 bolts that are 1/2" in diameter and 1 1/4" long. How much must she cut from each bolt? (5/8")

4. A cook has 15 1/3 lb. of potatoes. He uses 5 3/4 lb. in potato soup. How much does he have left? (9 7/12)

5. A carpenter needs to find the following distances:
   A shelf is 6 1/4 ft. long. She needs to cut off 4 3/8 feet. How much will be left? (1 7/8)
   A piece of molding is 18 1/3 ft. long. She needs to cut one piece 5 2/3 feet, and another piece 6 1/6 feet. How much will be left? (6 1/2)

6. Make up at least 3 problems that you might encounter in work you wish to do. Trade with a friend and work the problems.

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Additional Practice Problems:

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Duncan, et. al., Modern School Mathematics Structure and Use, (green copy and brown copy), Houghton Mifflin Co., Boston. Available in Junior Highs.

Geir, Alvin & Lamm, Nathaniel, Mathematics and Your Career, AMSCO School Publications, New York, 1978. Excellent source of application problems, available from the VRE.

Goozner, Calman, Arithmetic Skills Workbook, SMSCI School Production, 1973. Available at Hickman, has many application problems.

Lankford and Goe, Consumer Activities Book, Harcourt, Brace Jovanovitch, 1974. Available at Ellis Library. This book has some good application problems for consumers.

Moore, George, Practical Problems in Mathematics for Automotive Technicians, Delmar Publishers, Albany, New York. Available from the VRE. This book has difficult, but very realistic problems for auto repair.

Rausmussen, Steven, Key to Fractions Books 1-4, Key Curriculum Project, 1980. Available from the VRE, this book is self-directed. It has a clear, concise approach to fractions. It is a good resource if the students you teach are having difficulty.

Studebaker, Gordon & Studebaker, John, Scholastic Skills Book, Computational Skills K, FRACTIONS, Scholastic Books, 1980. Rather simplistic. This book offers lessons in fraction theory and adding and subtracting fractions. Available from Scholastic, or at Jefferson Junior High.

Ideas for Teaching:

Engleman, Siegfried, Preventing Failure in the Primary Grades, SRA, 1969. Has a very precise way of introducing fractions that may be helpful to students who are having great difficulty.

Marks, John, Purdy, Kinney and Hiatt, Teaching Elementary School Mathematics for Understanding, McGraw-Hill Book Company, 1975. Has many hands-on experiences to introduce fractions.

Smith and Backman (ed), Games and Puzzles for Elementary and Middle School Mathematics, 1975. These readings from the Arithmetic Teacher offer lots of games and activities for reinforcement.

Games

Junge, Charlotte, A Game of Fractions.

Rode, Joann, Make a Whole-- A Game Using Simple Fractions.

INSTRUCTIONAL MODULE

ACCESS SKILL: PHYSICAL DEMANDS MOVEMENTS

TASK ANALYSIS STEPS: A-F

VOCATIONAL AREA:
Auto Mechanics
Machinist
Carpentry
Heating and Air Conditioning
Offset Lithography
Diesel Mechanics
Welding
Auto Body

ACTIVITY	MATERIALS/RESOURCES
TASK A: The student will bend, reach, stoop, push, and pull appropriately without assistance	
1. Introduce the lesson to the students by telling them how important it is to move the body in the safest and best manner. Ask students to demonstrate how they would pick up a box on the floor, push a heavy object (such as a refrigerator), lift a heavy object (such as a television, etc.).	
2. After the students have shown their way of lifting, stooping, pushing, pulling, and bending, demonstrate the appropriate way through miming these methods. (act out the wrong way and then the right way. Do it in silence - possibly even in a dark room with a bright light on you. Better yet, have a mime come in to your classroom to demonstrate for you.)	Guest mime
3. Put out some large objects in your room and show the students the proper ways of lifting, moving, or rearranging the objects. For instance, lift a chair the proper way - demonstrate the proper method of bending at the knees and keeping the back straight and then lifting--using the arms. Or, ask the students to push the file cabinet and point out that when you get a really heavy object such as a file cabinet you should plan ahead and ask someone to help you.	Things to lift: desk, chair, file cabinet, large boxes (empty and full) people, small objects off the floor, light weight and heavy objects up high on a shelf
4. Use Worksheets A4 and A4a to demonstrate to the students the proper methods of lifting.	Worksheets A4, A4a
5. Show the students the film: "A New Way to Lift" which demonstrates the proper methods of lifting and the results of improper lifting. (8 minute film)	A New Way to Lift" available from the Academic Support Center, UMC
6. Invite a guest speaker into the classroom to discuss the proper methods of lifting and why it is done that way. Physical therapists are doing more and more of this type of activity and might even consider putting on an evening program for the school or the class and their parents.	Guest speaker: Physical Therapist
7. One at a time, ask the students to demonstrate the proper methods they have learned. Review this lesson often to make it become a healthy habit.	
TASK B: The student will lift up to and including 50 pounds of weight	
1. After learning how to lift, it is important to gradually learn how much you can lift. Before doing this portion of the unit, make sure students have no physical problem which would keep them from being able to lift 50 pounds.	

ACTIVITY	MATERIALS/RESOURCES
TASK B: CONTINUED	
2. Introduce the lesson to the students by asking them what kinds of workers in their area of vocational choice might have to lift 50 pounds. After you have named a few, ask the students why they think it would be important to learn to lift up to 50 pounds. Students should recognize that workers in horticulture, auto service, building trades, etc. have to lift heavy objects in order to do their job. There is not always a machine or someone else to do the job. Somewhere along the line, you are going to be that "somebody else".	
3. Test the students' strength by handing each student a 5 pound sack of flour, sugar, or sand. Ask the students to lift the 5 pound bag as high as he/she can comfortably and time him/her to see how long he/she can hold that bag. Gradually increase the time the bag can be held by each person.	5 pound bag of sand, flour, sugar, etc.
4. Once the student can lift the 5 pound bag of flour with both the left hand and the right independently for 3 minutes, work up to the lifting of 10 pounds of the same or similar weight. the student to lift 10 pounds of weight with his/her right arm for up to 2 minutes. Check each student individually.	10 pound bag of sand, etc.
5. Fill a bag with 20 pounds of sand and demonstrate to each student the proper way of lifting (see previous activity) 20 pounds using both arms to lift. Require each student to lift 20 pounds of weight and hold it to the count of 60.	
6. Put 30 pounds of weight in a box and demonstrate the proper way of lifting. Each child should lift the 30 pound weight and put it back down slowly--without dropping it. Once the student has demonstrated the proper way to lift such a weight, ask him/her to lift the 30 pound weight 10 times without stopping.	
7. Give the students some practical experiences lifting weights of 30, 40, and 50 pounds by assigning him/her to plant a small tree (30-40 pounds - including dirt), or lifting other heavy objects around the classroom and home.	Heavy items that might be used in vocational projects
8. If your school has a weight room, make use of it. Ask the coach or one of the regular weight lifters to demonstrate the use of the weight lifting machines and provide an opportunity for students to work out on it daily or every other day.	Weight room, guest demonstration
9. Demonstrate the appropriate way to do chin-ups. Have the students try to do at least 5 chin-ups each day.	Chin-up bar
10. Invite a professional weight lifter or tai-kwan-do instructor to demonstrate their muscles and strength and talk about how they keep in shape.	Guest speaker
TASK C: The student will lift up to 50 pounds of weight repeatedly for a prolonged period of time	
1. Once the student has developed the strength he/she needs to lift 50 pounds of weight, discuss the need to be able to lift 50 pounds of weight repeatedly. (Many jobs do not require that you just lift one thing, but probably many heavy things, and you must be strong enough to do so.)	

ACTIVITY	MATERIALS/RESOURCES
TASK C: CONTINUED	
2. Using bar bells, arm weights, chin-ups, push-ups, and large boxes, require the students to lift up to 50 pounds of weight 12 times per hour (once every 5 minutes). Check the student to be sure he/she is using proper body position and doesn't start to use his/her body improperly after a few lifts.	Bar bells, large heavy boxes, small heavy boxes, buckets of paint or water, bails of hay, etc.
3. Encourage the student to lift heavy objects in the classroom whenever heavy things need to be lifted. Make sure the student is using the best possible methods to lift.	
TASK D: The student will demonstrate agility	
1. Introduce the lesson by telling the students that they are going to work on becoming agile. Ask if anyone knows what agility is and why they need that ability. (Ability to move with ease and quickness is needed by everyone in order to show interest, to adequately perform at work, to complete tasks, etc.) Discuss a person who moves very slowly and demonstrate. Then ask why that person might not get the job done. Then ask one of the students who is usually very slow or lacking in agility to demonstrate the opposite. Make sure he/she adequately demonstrates smooth, quick movements.	
2. Discuss what would require agility in the vocational area for which they are preparing.	
3. Show the many forms of agility and movement as a graceful form of expression by showing "Learning Through Movement," a 30 minute film.	"Learning Through Movement" is available from the Academic Support Center - UMC
4. Practice the skills learned in Tasks A-C and increase the speed with which the task is completed. Check speed with a stop-watch.	Stop-watch
5. Using an aerobic record, demonstrate various moves in aerobics to the students and let them practice the moves until they have an idea of how to move their body upon command. Then turn on the music and begin moving. There are several records out on the market and your school library might have copies of various ones you'd like to use. (Be sure to practice the steps ahead of time).	Aerobics record, cassette tapes or videos
6. Discuss how quick jerky movements may be fast and might get the job done, but might cause accident or injury. Moving objects around on a cart requires more than simple pushing It also requires concentration and planning. For example: If we were to move a cart with a television set down the hallway and not look where we were going, we might hit a bump or run into someone and the TV would fall off - shattering! Practice moving empty boxes on a cart, then have light-weight non-breakable objects in the boxes. Later put heavy objects on the carts and assign the students to move them through the hallways quickly, but safely--telling ahead of time what they are going to do to insure safety of that item (such as holding onto the object just in case we do hit a bump, etc.). Contact the parents of the students and explain to them the lesson on agility. Ask that they watch their son or daughter at home and remind them to practice agility--to move quickly, smoothly, and gracefully.	Moving cart, dolly, boxes, light-weight non-breakable objects, heavy objects

ACTIVITY	MATERIALS/RESOURCES
TASK E: The student will demonstrate good eye-hand coordination	
1. Explain and introduce the lesson on eye-hand coordination by timing the students' ability to screw and unscrew screws on a board. This requires skills other than eye-hand coordination, but also requires that skill and is a fun way to introduce the lesson. Or have the students put the correct pegs into holes as rapidly as possible.	Screws in board, screwdriver, peg board and golf tees or pegs
2. Ask the students to be honest with themselves about how much trouble they had completing this task in a given period of time. This gives them some indication as to why they are working on this task. Discuss various reasons why eye-hand coordination is important and what jobs require such a skill. Impress upon the students the need to learn this skill.	
3. Give each student a piece of cardboard with a simple shape on it. Assign the students to trace around the shape and then cut it out. Make sure the student can cut out the shape without any odd angles or frayed edges before moving on to a more difficult shape. Begin with circles, squares, and triangles and progress to tracing objects such as screwdriver, hammers, etc. and cutting them out.	Carboard, pencils, scissors, screwdriver, hammer, etc.
4. Break the students into pairs and give each pair a 200 piece puzzle (fairly large pieces) and see who can finish first. The pair that finishes first gets to move on to putting together a 500 piece puzzle. Time students to see which group can finish first. Because this might take several days to complete and can become monotonous after a short period of time, allow approximately 20 minutes per day for this activity.	200 and 500 piece puzzles, timer
5. Drill 24 holes in a small board and give the student 24 nuts and bolts. Time the students performance on putting each nut and bolt in each hole and tightening. Eventually give the students a timer or stop watch and allow them to time themselves to cut down on the amount of time it takes to complete this task.	6"x 6" board with 24 holes drilled in it, 24 nuts and bolts, timer or stop watch
6. Practice writing skills and work toward forming the letters accurately. Accept only papers with accurately formed letters. Some students might benefit by using a pencil gripper - these are available for the student to purchase at the University Book Store.	Pencil and paper
7. Decide on a theme for improving eye-hand coordination and allow the students to develop a bulletin board display using some of their skills and showing improvement. Encourage them to trace from pictures, cut items, build small displays for the board, etc.	Paper, pencils, scissors, hammer, nails, screwdriver, etc.
TASK F: The student will accurately determine left from right	
1. When teaching left/right discrimination with the junior high/high school student, remember to keep the skills fairly interesting and limit the time. Work with the student on a daily basis for short periods of time to learn the skill with little frustration. Begin with simply telling the student that he/she is going to learn to tell left from right. Discuss the reasons why this would be necessary (to know which tire to change, which hand to use, which direction to turn, how to open a lock, where to turn a car, etc.). Spend as much time as is needed in order for the	

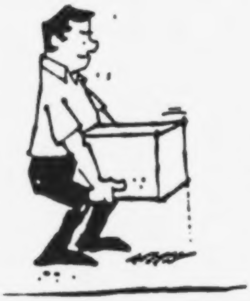
ACTIVITY	MATERIALS/RESOURCES
TASK F: CONTINUED	
student to correctly raise the hand called for 9 out of 10 times. For example: The teacher would say, "Raise your right hand." The student should immediately raise his/her right hand without hesitation. If there is any hesitation, you cannot count that time as accurate. Repeat until the student has raised the correct hand 9 out of 10 times.	
2. Once the student is able to do the above, ask him to pick up the items you name with the correct hand. For example: "Pick up the hammer with your right hand and the nail with your left." The student should do this correctly (even when you switch which hand is to pick up which item), 9 out of 10 times.	Hammer, nails, etc.
3. If the student is having trouble with any part of the activity stand him/her in front of a mirror and mark on the full-length mirror the shape of his body. Draw a line down the center of the shape and mark one side right and the other side left. Let the student stand in front of the table until he/she is able to do the tasks without hesitation.	Magic marker, full-length mirror
4. Place 2 items in front of the student (a pot and some soil, a hammer and some nails, a screwdriver and some screws, a pencil and some paper, etc.) Ask the student to pick up one item with one hand and the other item with the other. The student should at this point tell as he picks up the item which hand he/she is using. There should be no hesitation in the accuracy in 9 out of 10 times.	Flower pot, soil, screws, screwdriver, hammer, nails, pencil, paper, etc.
5. If the student is having trouble at this point you might try outlining the student's body on the chalkboard and labeling one side left and one side right. Tell the student that he/she is facing you, so which side would be the right side of his/her body and which would be the left. If he/she is standing with back to you, he/she should be able to quickly tell which is left and which is right.	Chalkboard, chalk
6. Plan a project (a design of a garden, a model house made of cardboard, etc.). Write directions as to where the student should place certain items in his project. For example: to the right of the raddishes you should plant the lettuce; to the left of the kitchen should be the bathroom; put the couch against the front wall of the living room on the right side, etc.	Materials needed will vary according to the project selected
7. Using game pieces from Monopoly, place the houses on a make-believe town that you and the students have drawn on cardboard. Give the students assignments as to where to place the houses. Later have the student tell you where he/she placed certain houses on that game board.	Poster board, Monopoly game pieces

Worksheet A4

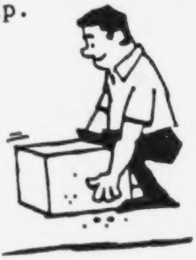
Your backbone or spinal column is the nerve network of your entire body. The spinal column is designed to support the upper section of the body, but the muscles in the back are not designed for lifting and severe strain. The back muscles are flattened and offer support to the spinal column. By contrast, the muscles in your upper thighs and lower leg are the largest in your body--and the strongest. They are designed for running, pulling, jumping, and lifting. You must learn to use your legs to lift--not your back.

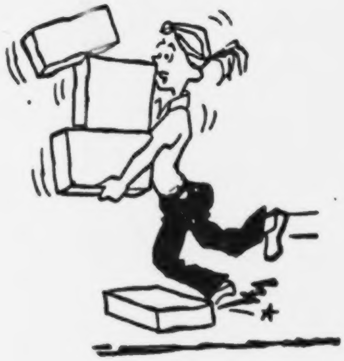
When picking up a carton--even one that appears light in weight--bend your knees and let your leg muscles lift the weight. Keep your back in a straight line. Strain comes from bending the back slightly at an angle when lifting. Even more dangerous is to twist the back slightly to one side when lifting. A full bend is better than a half bend (Luter, 1979).

Lift the load straight up--smoothly and evenly. Pushing with your legs, keep the load close to your body.



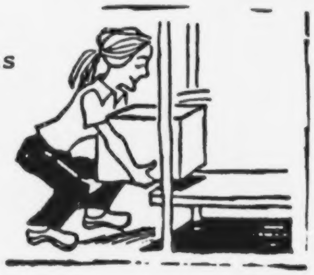
Setting the load down is just as important as picking it up. Using leg and back muscles, comfortable lower load by bending your knees. When load is securely in place, release your grip.

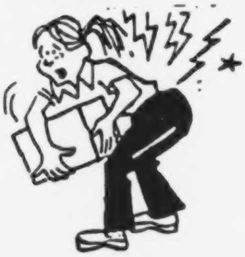




Stack material in such a way as to permit full view while carrying.

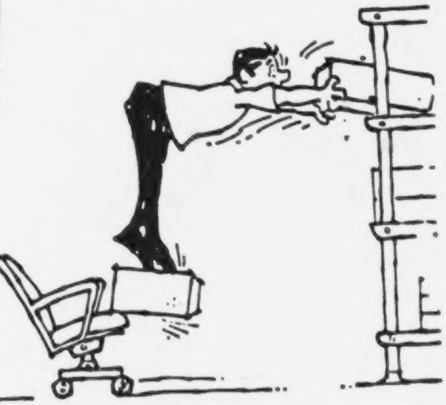
Avoid strain by storing heavy objects at least 12 inches above the floor.





Avoid awkward positions or twisting movements while lifting.

Overreaching and stretching to reach overhead objects may result in strains or falls. Use a ladder instead of chairs, boxes, etc.



Worksheet A4a

PROPER LIFTING TECHNIQUES WORKSHEET

1. Size up the load to be lifted. Do not even attempt to lift a large load alone. If you have any doubt about your ability to lift an object, ask for assistance.

2. Make sure you are well-balanced. Your feet should be apart to give you a broad base of support if you are lifting a heavy object or person.

3. Move close to what you are to lift. Do not reach for any object that is up high or over far. Get your body close to the object to be lifted. If it is up high, get on a ladder. (Use the proper method of climbing a ladder. See the Safety Module.)

4. Keep your back straight. Line up your back so you don't strain it. Bend at the knees and hips--NOT the back.

5. As you lift, straighten your legs. When you bend to lift something, bend your knees. To lift it, straighten your legs.

6. If you need to turn, shift the position of your feet, but do NOT turn your body. Twisting injures muscles.

7. If you are lifting with someone, lift smoothly. This avoids strain on your back which you would get from jerky movements. Count with the person to make sure the lift is smooth.

8. Push or pull a heavy object whenever possible. It is easier and safer.

9. Remember to use these skills all of the time to keep yourself safe.

VOCATIONAL AREA:
Auto Body
Auto Mechanics

INSTRUCTIONAL MODULE

ACCESS SKILL: **PREPARE FOR THE WRITTEN PORTION OF THE MISSOURI OPERATORS LICENSE EXAM**

TASK ANALYSIS STEPS: A-L

ACTIVITY	MATERIALS/RESOURCES
TASK A: Identify eligibilty requirements for acquiring a Missouri Operators license	
1. Introduce vocabulary words to students. Discuss the meaning and give the student examples for each of the vocabulary words. Have student write the definitions for each vocabulary word. Vocabulary Words: resident non-resident license suspended revoked violations operator chauffeur application examination renewal	Transparency, overhead projector, marker Make flashcards from vocabulary words
2. Have the students read pages 2-7 of Missouri Driver's Guide. Read and discuss each section of Chapter One separately (for example read "New Resident Clearance," "Driver's License Restrictions," "Types of Licenses," etc.).	Missouri Driver's Guide (1987)
3. Present students with a worksheet to be completed individually. The worksheet skills would include sections over vocabulary and comprehension skills from the lesson. Go over the worksheet as soon as completed to make sure concepts are learned correctly.	Worksheet A3
4. Have students place vocabulary words and worksheets in a notebook for future reference.	
TASK B: Identify procedures for taking the driver examination	
1. Introduce vocabulary words to students. Discuss the meaning and give the students examples for each of the vocabulary words. Have the student write the definition for each vocabulary word. Vocabulary Words: examiner written test vision test driving test vehicle curb parallel right left intersection signs signals	Transparency, overhead projector, marker Make flashcards from vocabulary words When possible, laminate pictures depicting vocabulary words on posterboard
2. Have students read pages 8-12 of the Missouri Driver's Guide. Read and discuss each section of Chapter 2 separately (for example, "Who Must Take the Driver Examination?" "Written Test," "Vision Test," "Driving Test," etc.). The discussion should include comprehension questions over the most important aspects of Chapter 2.	Missouri Driver's Guide
3. Present students with a worksheet to be completed individually. The worksheet would include sections over vocabulary and comprehension skills from the lesson. Go over as a group upon completion.	Worksheet B3

ACTIVITY	MATERIALS/RESOURCES
TASK B: CONTINUED	
4. Have students place vocabulary words and worksheets in a notebook for future reference.	
TASK C: Identify highway markings, traffic signs, lights, and signals	
1. Introduce vocabulary words to students. Discuss the meaning and give students examples for each of the vocabulary words. Have student write the definitions for each vocabulary word. Vocabulary Words: no-passing zone — four lane prohibited zones — solid yellow stripe two-lane — broken yellow stripe	Transparency, overhead projector, marker Make flashcards from vocabulary words
2. Have the students read pages 13-14 of the Missouri Driver's Guide. Read and discuss pages 13-14. The discussion should include comprehension questions over the most important aspects of Chapter 3 (pp. 13-14).	Missouri Driver's Guide
3. Present students with a worksheet to be completed individually. The worksheet would include sections over vocabulary and comprehension skills from the lesson. Go over as a group upon completion.	Worksheet C3
4. Have students place vocabulary words and worksheets in a notebook for future reference.	
5. Take students out into the community to see the actual highway markings. Have them verbally identify as a group or or videotape showing highway markings.	Transportation (bus, car) or bike Video recorder, videotape
6. Use the same procedure as in previous tasks to teach the following vocabulary words and the following text pages. Vocabulary Words: caution — traffic control signals dangerous — flashing signal hand signals — railroad crossing	Worksheet C6 Transparency, overhead projector, marker Make flashcards
Have students read pages 15-20 of the Missouri Driver's Guide.	Missouri Driver's Guide
7. Take students out into the community to see the actual traffic and regulatory signs. Have them verbally identify as a group.	Transportation (bus, car, bike)
8. Give worksheets of traffic and regulatory signs, label appropriately.	Worksheets C8, C8a
9. Give worksheet with shape only, label the sign appropriately.	Worksheet C9
10. Have students make the traffic and regulatory signs for bulletin board or area in room. Use traffic and regulatory signs' words for spelling.	Colored posterboard, markers/pen and ink printing machine (letters, paint, roller)
11. Have actual traffic signal in class. Have students verbally identify what to do when a color appears.	Traffic signal

ACTIVITY	MATERIALS/RESOURCES
TASK C: CONTINUED	
12. Teacher demonstrates hand signals. Students verbalize what to do when observed.	
13. Teacher/peer calls out hand signal. Students demonstrate actual hand signal according to the signal called out (left turn, right turn, slow down/stop).	
TASK D: Identify distinctive features and special techniques for driving on an interstate highway	
1. Follow previous procedures. Vocabulary Words: interstate controlled access interchange freeway rearview mirror blind spot prohibited right-hand lane left-hand lane expressway	Transparency, overhead projector, marker Make flashcards from vocabulary words
2. Have students read pages 19-29 of the Missouri Driver's Guide. Read and discuss each section of Chapters 4-6.	Missouri Driver's Guide
3. Present students with a worksheet to be completed individually. The worksheet would include sections over vocabulary and comprehension skills from the lesson. Go over worksheet as soon as completed to make sure concepts are learned correctly.	Worksheet D3
4. Have students place vocabulary words and worksheets in a notebook for future reference.	
5. Speed Limits a. Have class identify the maximum highway speed (55 mph, and 65 mph of interstates). Teacher writes on board. b. Have students break into 2 groups. One group will be "for" the 55 mph law, and one group "against." Each group will list the advantages of their assigned side, and prepare to debate.	Paper, pens
6. Proper procedures for Stopping Teacher will draw a car on the transparency showing the proper place to stop in these 3 situations: at a line, at a crosswalk, before reaching an intersection.	Transparency non-permanent flair
7. Given a worksheet of 3 different situations, each student will draw a car or rectangle or other representative shape to show the proper procedure at stop signs.	Worksheet D7
8. Take students out into the community and observe other drivers. Critique the other drivers, identifying proper and improper stopping procedures.	Transportation (bus, car)
9. Proper Turning Techniques Teacher will draw a car on the transparency showing the proper turning techniques in the 6 turning situations. Draw the car and then continue the driving path with directional arrows. 6 situations: left turn and right turn one-way onto a two-way two-way onto a one-way two-way onto a two-way	Transparency

ACTIVITY	MATERIALS/RESOURCES
TASK D: CONTINUED	
10. Use car track and toy cars. Demonstrate each turn properly using the toy cars. (Have the track set up with one-way signs and stop signs so student knows type of turn to make.)	Car track with signs, toy cars
11. Given worksheets with titles of 4 situations, each student will draw a car or rectangle or representative shape to show the proper turning techniques for the title. The rest of the driving path will be shown by directional arrows.	Worksheets D11, D11a,
12. Take students into the community and observe other drivers. Critique the other drivers identifying proper and improper turning techniques.	Transportation (bus, car)
13. When to Yield the Right of Way	
a. Teacher will show the situations in which a vehicle should yield right of way. Discuss with students stressing emergency vehicles, school busses, postman.	Transparency, overhead projector non-permanent flair
b. Use car track and toy cars. Demonstrate each of the situations in which a vehicle should yield the right of way. (Have track set up with all signs, emergency vehicles, etc.).	Car track with signs, emergency vehicles, toy cars
14. Parallel Parking/Parking	
Take students into community and demonstrate parallel parking procedures. Use of videotape showing procedures is also a possibility.	Transportation (car, taxi) Videotape recorder, videotape
15. Have each step of parallel parking procedure written on index cards. The students will put them in sequential order.	index cards with each step of parallel parking procedures
16. Use car track and toy cars. Demonstrate the proper procedure for parallel parking. Have other cars set up in spaces in front and behind open parallel parking space.	Car track with parallel parking marks, toy cars
17. Group discussion on how to park on hills. Use transparency to show direction of wheels to be turned.	Transparency, overhead projector, non-permanent flair
TASK E: Identify rules of the road	
1. Follow previous procedure for vocabulary words. Vocabulary Words: Speed limit miles per hour reaction time braking time maximum minimum pedestrians crosswalk two-way street municipalities parallel parking emergency vehicle no-parking zone	Transparency, overhead projector, marker, Make flashcards from vocabulary words
2. Have students read pages 19-29 of the Missouri Driver's Guide. Read and discuss each section of Chapter 5 separately (for example: "Missouri Speed Limits," "Where to Stop for Stop Sign," "Turning Movements," etc.). The discussion should include comprehension question over the most important aspects of Chapter 5.	Missouri Driver's Guide
3. Present students with a worksheet to be completed individually. The worksheet would include sections over vocabulary and comprehension skills from the lesson.	Worksheet E3

ACTIVITY	MATERIALS/RESOURCES
TASK E: CONTINUED	
4. Have students place vocabulary words and worksheets in a notebook for future reference.	
5. Take students out into the community and have the teacher explain how to cross, enter and leave the highway without interfering with other vehicles. Demonstrate the following interchanges: 1. Cloverleaf 2. Diamond 3. Directional 4. Trumpet	Transportation (bus, car)
Can use teacher made videotape if transportation is not available.	Videotape recorder, videotape
6. Break class into 4 groups. Assign 1 interchange per group. Have each group draw the type of interchange assigned, using directional arrows on how to enter and exit the highways on transparency. Include when this type of interchange is most commonly used.	Transparency, non-permanent flair, ruler
7. Have class classify the interchanges found in your community or outlying areas.	
8. Have class list advantages and disadvantages/hazards of each type of interchange and cautions that should be taken.	Board/chalk or Transparency, overhead projector, non-permanent flair
TASK F: Demonstrate an understanding of the point system and license penalties	
1. Follow previous procedure for vocabulary words. Vocabulary Words: speeding revocation intoxicated suspension careless and imprudent misrepresentation narcotics	Transparency, overhead projector, marker Make flashcards from vocabulary words
2. Have student read pages 30-37 of the Missouri Driver's Guide. Read and discuss each section of Chapter 6 separately (for example: "The Point System," "Driving While Your License is Suspended or Revoked," etc.). The discussion should include comprehension questions over the most important aspects of Chapter 6.	Missouri Driver's Guide
3. Present students with a worksheet to be completed individually. The worksheet would include sections over vocabulary and comprehension skills from the lesson.	Worksheet F3
4. Have students place vocabulary words and worksheets in a notebook for future reference.	
5. Review all vocabulary. Can use flashcards previously prepared.	Flashcards made from vocabulary words
6. Break into groups. Have teacher-made transparency describing each traffic violation. Have each of the small groups assign points they would deduct for this violation.	Transparency with violations described, overhead, projector, non-permanent flair

ACTIVITY	MATERIALS/RESOURCES
TASK F: CONTINUED	
7. Group discussion: Fairness of point value assignments.	
8. Group discussion: Advantages/disadvantages of point system. Should we have it? Does it really keep unsatisfactory drivers and violators from committing violations? Is the point system doing what it was intended to do?	
9. Guest speaker: State Highway Patrolman	Contact: State Highway Patrol, Jefferson City, MO, 314-636-5171
TASK G: Identify procedures to follow when involved in an accident	
1. Follow previous procedures for vocabulary words. Vocabulary Words: authorized — law enforcement officer victim — accident	Transparency, overhead projector, marker make flashcards from vocabulary words
2. Have students read pages 30-32 of the Missouri Driver's Guide. Upon completion, discuss the passage by including comprehension questions over the most important aspects of Chapter 7.	Missouri Driver's Guide
3. Present students with a worksheet to be completed individually. The worksheet would include sections over vocabulary and comprehension skills from the lesson.	Worksheet G3
4. Have students place vocabulary words and worksheets in a notebook for future reference.	
5. Teacher will write "insured motorist" and "uninsured motorist" on the board and ask students for a definition.	Board/chalk
6. Group discussion: Should all medical personnel be required to stop at the scene of an accident? Should there be a penalty for not stopping? Do the victims and their families have a right to sue the medical personnel who stopped at the scene of the accident when they were not obligated and did the best they could considering the circumstances?	
7. Have a paramedic give a presentation on basic first aid information and procedures to be followed at the scene of an accident.	Call Local Police Department to locate appropriate speaker
TASK H: Identify Missouri law regarding alcohol and driving	
1. Follow previous procedures for vocabulary words. Vocabulary Words: consent — blood alcohol content fined — breath test imprisoned — conviction	Transparency, overhead projector, marker Make flashcards from the vocabulary words
2. Have students read pages 33-35 of the Missouri Driver's Guide. Upon completion, discuss the passage by including comprehension questions over the most important aspects of Chapter 8.	Missouri Driver's Guide
3. Present students with a worksheet to be completed individually. The worksheet would include sections over vocabulary and comprehension skills from the lesson.	Worksheet H3

ACTIVITY	MATERIALS/RESOURCES
TASK H: CONTINUED	
4. Have students place vocabulary words and worksheets in a notebook for future reference.	
TASK I: Identify the requirements for motor vehicle titling and registration	
1. Follow previous procedures for vocabulary words. Vocabulary Words: application penalty fee odometer lien Certificate of Title vehicle registration Manufacturer's Statement of Origin license plate	Transparency, overhead projector, marker Make flashcards from vocabulary words
2. Have students read pages 41-43 of the Missouri Driver's Guide. Read and discuss each section of Chapter 11 separately (for example, "What You Need to Register Your Vehicle," "Odometer Reading," "Where to Get a Title" and "Vehicle Registration"). The discussion should include comprehension questions over the most important aspects of Chapter 11.	Missouri Driver's Guide
3. Present students with a worksheet to be completed individually. The worksheet would include sections over vocabulary and comprehension skills from the lesson.	Worksheet I3
4. Have students place vocabulary words and worksheets in a notebook for future reference.	
5. Have index cards with description of documents and procedures. Choose the ones that apply to vehicle registration.	Index cards with documents and procedures listed of several items
TASK J: Identify motor vehicle inspection and equipment regulations	
1. Follow previous procedures for vocabulary words. Vocabulary Words: headlights motorcycle brakes mufflers safety glass inspection station safety belts windshield wiper mechanical	Transparency, overhead projector, marker Make flashcards from the vocabulary words
2. Have students read pages 38 and 44-54 of the Missouri Driver's Guide. Read and discuss each section separately (for example: "Motorcycle Inspection," "Equipment Regulations," and "School Bus Regulations"). The discussion should include comprehension questions over the most important aspects.	Missouri Driver's Guide
3. Present students with a worksheet to be completed individually. The worksheet would include sections over vocabulary and comprehesion skills from the lesson.	Worksheet J3
4. Have students place vocabulary words and worksheets in a notebook for future reference.	
5. Teacher writes "vehicle inspection" and "equipment regulations" on the board. Students generate definition with teacher guidance.	Board/chalk

ACTIVITY	MATERIALS/RESOURCES
TASK J: CONTINUED	
6. Go to the vocational-technical school class in auto mechanics and have student/teacher demonstrate how a safety inspection is performed, what equipment must be in regulation, and what to inspect regularly to make sure vehicle is in safe working order. Or go to the local safety inspection station.	Auto mechanics class or inspection station
TASK K: Identify safety procedures for defensive driving	
1. Follow previous procedures for vocabulary words. Vocabulary Words: hydroplaning — defensive driver accelerate — manual transmission pavement — carbon monoxide	Transparency, overhead projector, marker Make flashcards from vocabulary words
2. Have students read pages 55-63 of the Missouri Driver's Guide. Read and discuss each section of Chapter 14 and 15 separately (for example: "Defensive Driving," "Night Driving," "Winter Driving," "Wet Pavement," etc.). The discussion should include comprehension questions over the most important aspects.	Missouri Driver's Guide
3. Present students with a worksheet to be completed individually. The worksheet would include sections over vocabulary and comprehension questions over the most important aspects.	Worksheet K3
4. Have students place vocabulary words and worksheets in a notebook for future reference.	
TASK L: When given a SAMPLE drivers examination consisting of 20 multiple choice questions, the student will complete the test with 75% accuracy	
1. Review vocabulary words by using flashcards prepared during each lesson.	Flashcards with vocabulary words
2. Review information for the examination by having students each select a partner. The students may review for the test by using the worksheets they have kept in a notebook from each lesson. Each student should also have a copy of the Missouri Driver's Guide to use for study purposes.	Worksheet compiled in the notebook from each lesson taught Missouri Driver's Guide
3. Review information for the examination by having each student prepare 5 test questions/answers from the Missouri Driver's Guide. The teacher would compile the questions into a worksheet or could orally present the questions to the students for discussion.	Missouri Driver's Guide
4. Give the students the SAMPLE drivers examination to be completed independently.	Worksheet L4

Worksheet A3

Eligibility Requirements for Acquiring a Missouri Drivers License

I. Vocabulary

Directions: Match the vocabulary word to its definition by placing the letter of the definition in front of the vocabulary word.

1. ___ resident
2. ___ license
3. ___ suspended
4. ___ revoke
5. ___ violations
6. ___ operator
7. ___ non-resident
8. ___ chauffeur
9. ___ application
10. ___ examination
11. ___ renewal

A. Formal permission from an authority to drive

B. A person who lives in Missouri

C. A person who does not live in Missouri

D. To temporarily take a drivers license away from a person

E. The act of getting a drivers license when your old license is 3 years old

F. A test--either written or driving

G. A written request

H. A person who drives other people from one location to another

I. Any person who operates a motor vehicle

J. To take away a persons drivers license permanently

K. An activity

Worksheet A3 Continued

II. Comprehension

Directions: Answer the following questions in the space permitted below

A. List 7 reasons that you may not by licensed in Missouri.

1.
2.
3.
4.
5.
6.
7.

B. What are the qualifications to receive an operator's license in Missouri?

C. What are the qualifications to receive chauffeur's license in Missouri?

D. At what age is a person permitted to apply for a Temporary Instruction Permit? ________

E. How often must a driver in Missouri renew his operator's license?
____

F. Name 2 restrictions that may be placed on your drivers license.

Worksheet A3
ANSWER KEY

Refer to pages 2-7 of the Missouri Driver's Guide.

I. Vocabulary

1. B
2. A
3. D
4. J
5. K
6. I
7. C
8. H
9. G
10. F
11. E

II. Comprehension

A. Any person, applying as an operator, who is under 16 years old.

B. Any person, applying as a chauffeur, who is under 18 years old.

C. Any person whose license is currently revoked (taken away).

D. Any person whose license is suspended in Missouri or any other state.

E. Any person the court judge declares physically or mentally unable to drive safely.

F. Any person who does not have the proper identification.

(Other answers from pp. 2-7 of the Missouri Driver's Guide are acceptable).

B. To qualify you must be at least 16 years of age and pass a driver examination which consists of standardized written, vision and driving tests.

C. To qualify you must be at least 18 years of age and pass a driver examination which consists of standardized, written, vision and driving tests.

D. 16 years old

E. Every 3 years

F. 1) If you need glasses to pass the vision test given to all applicants, you will be required to wear them while driving.
   2) If you need certain mechanical devices to help you operate a motor vehicle, the department will require their use and must approve any such device used.

(Other appropriate answers on pp. 4-5 of Missouri Driver Guide.

Worksheet B3

The Driver Examination

I. Vocabulary

Directions: Fill in the blanks with the appropriate vocabulary word from the list below.

- examiner
- written test
- vision test
- driving test
- vehicle
- curb
- parallel
- intersection
- signs
- signals

1. When a person takes the driver test he will be assisted by the ________________________.

2. ____________________ and ____________________ are important in directing traffic safely.

3. To qualify for an operator's license the person must be 16 years old and pass an examination which consists of a ______________, a ____________________, and a ______________________.

4. The edge of a street is called a ________________.

5. A car, truck, or bus can each be called a type of ________________.

6. Where two streets cross each other you have an __________________.

7. When _______________ parking it is important to check the rearview mirror for traffic.

Worksheet B3 Continued

II. Comprehension

Directions: Match the question to its correct answer by placing the letter of the correct answer in front of the question.

1. __ What are ways to satisfactorialy prove the age of an applicant for a drivers
2. __ Who must take the driver examination?
3. __ What are the characteristics of the written part of the drivers test?
4. __ What is the proper driving posture?
5. __ What are some reasons for failing the driving test?
6. __ Why is the driving portion of the test important?
7. __ Why is the written portion of the test important?
8. __ What happens if an applicant fails the vision test?

A. Applicants for an original Missouri operators license, new residents who have allowed their license to to expire.

B. Accumulation of more than 30 points, involvement in an accident with another vehicle

C. It gives the examiner a chance to see how the applicant can handle a car.

D. Birth certificate, passport court record

E. The applicant is referred to a vision specialist

F. 20 multiple choice questions of which you must answer 15 of the questions correctly

G. It gives the examiner an opportunity to see the applicants knowledge of traffic laws and rules for safe driving

H. Both hands on the wheel at one time

Worksheet B3
ANSWER KEY

Refer to pages 8-12 of Missouri Driver's Guide.

I. Vocabulary

1. examiner
2. signs, signals
3. written test
   driving test
   vision test
4. curb
5. vehicle
6. intersection
7. parallel

II. Comprehension

1. D
2. A
3. F
4. H
5. B
6. C
7. G
8. E

Worksheet C3

Highway Driving

I. Vocabulary

Directions: In the space provided below, write a sentence for each of the following phrases. You may refer to pages 11-14 in the Missouri Driver's Guide.

no-passing zone
solid yellow strip
two-lane
broken yellow strip
prohibited zones
four-lane

II. Comprehension

Directions: Look at the illustrations and answer the following questions.

1. What does the dotted line in the center of the highway mean?
2. Use arrows on the illustration to show which way the traffic is going?
3. What does the solid line in the middle of the highway mean?

Worksheet C3 Continued

4. What do the dotted lines on the road mean?

____

5. Use arrows on the illustration to show which way the traffic is going?

6. What does the double solid line in the center of the highway mean?

____

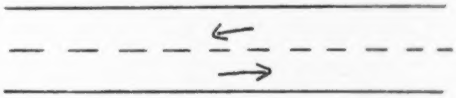
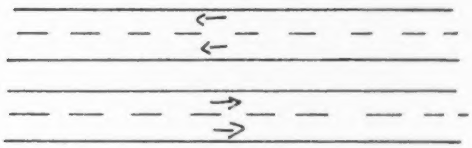
Worksheet C3
ANSWER KEY

Refer to pages 13-14 of Missouri Driver's Guide.

I. Vocabulary

Check for appropriate use of the vocabulary word in each sentence.

II. Comprehension

1. It is a way to separate the two lanes of traffic.
2. 
3. No-passing zone.
4. It is a way to separate the two lanes of traffic.
5. 
6. Never pass over these lines ---------.

Worksheet C6

Traffic Signs and Signals

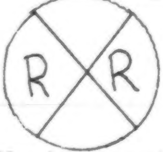
I. Vocabulary

Directions: In the spaces provided below write a sentence for each of the following phrases. You may refer to pages 13-14 in the Missouri Driver Guide.

Railroad crossing
flashing signal
caution
dangerous
hand signals
traffic control signals

II. Comprehension

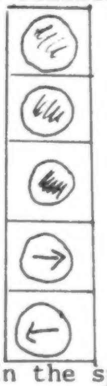
Directions: Using the illustrations answer the following questions.



1. What does this sign mean?

2. A flashing red light means

3. A flashing yellow light means



4. A red light requires

5. A yellow light

6. A green light means

7. A yellow arrow may appear after a green arrow. It means

8. A green arrow means

9. In the space provided below, draw the three hand signals which mean left turn, right turn, and stop. Please label each drawing.

Worksheet C6
ANSWER KEY

Refer to pages 13-18 of Missouri Driver's Guide.

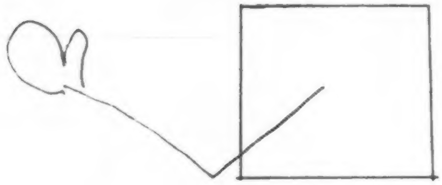
I. Vocabulary

Check for appropriate use of the vocabulary word in each sentence.

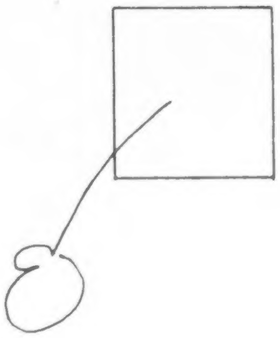
II. Comprehension

1. Advance Warning Sign for a railroad crossing.
2. To stop, the same as a stop sign.
3. You may proceed only with caution.
4. The driver to stop.
5. Warns that the signal is changing.
6. You may proceed if it is safe to do so.
7. That the signal is changing.
8. You may make a turn in the direction the arrow is pointing.
9.

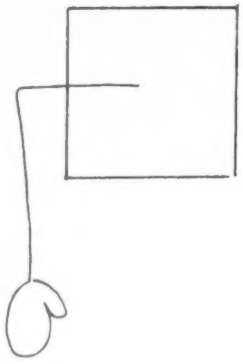
Right turn



Left turn

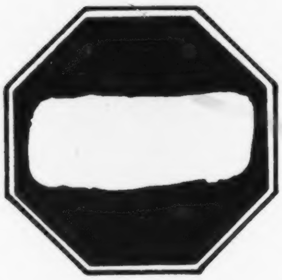


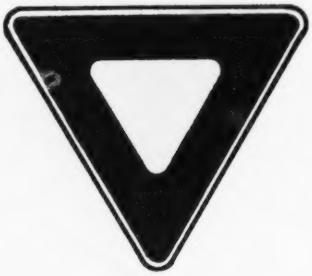
Stop

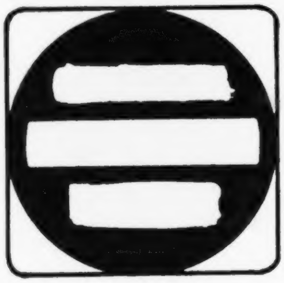


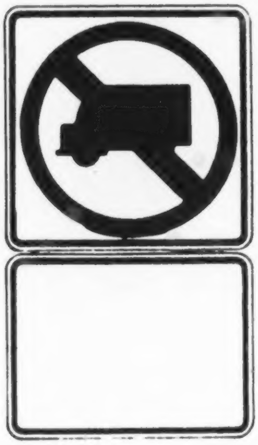
Worksheet C8

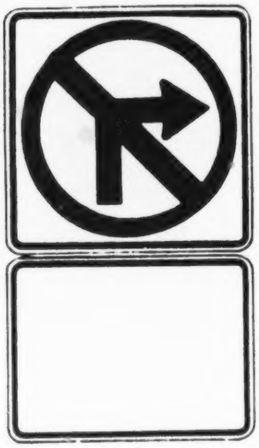
Regulatory signs: Label each sign appropriately and write the word(s) below each sign.

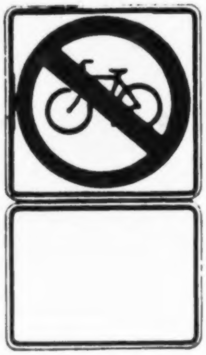


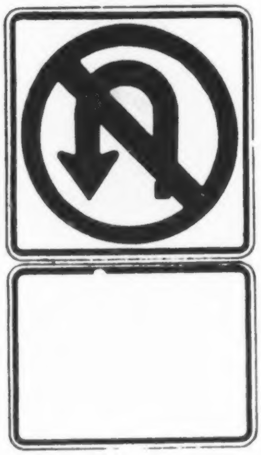


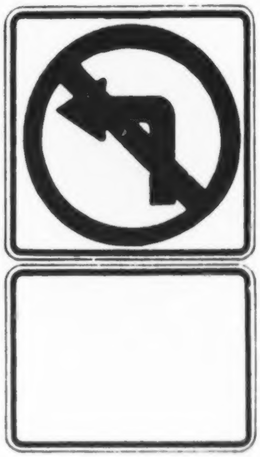


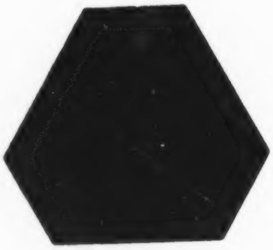






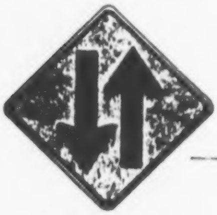


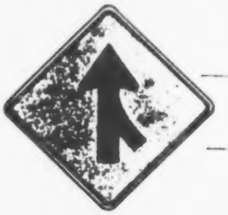


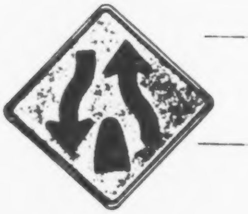


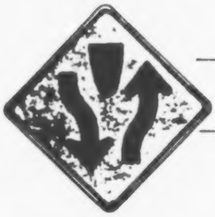
Worksheet C8a

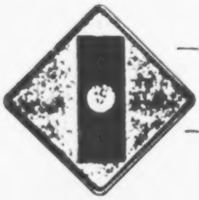
Traffic signs: Label each sign appropriately below.

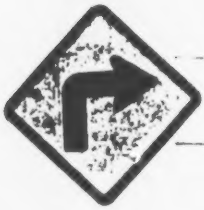


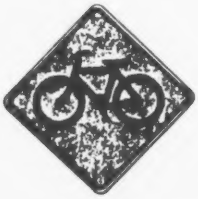


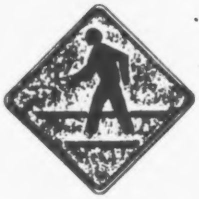


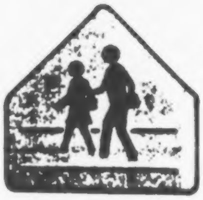


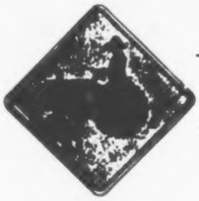


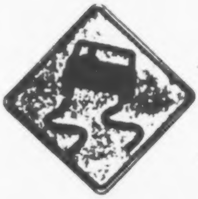


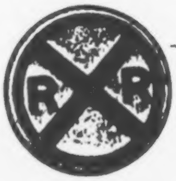






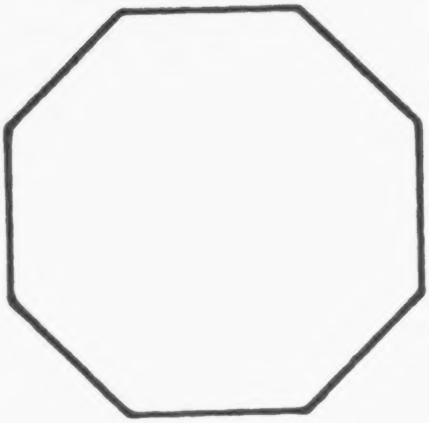


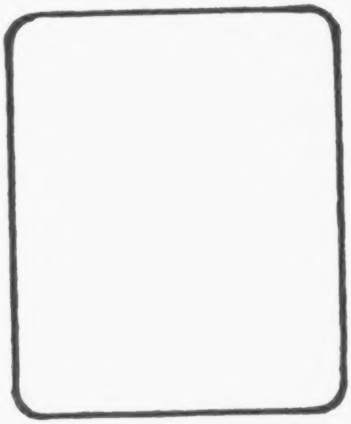


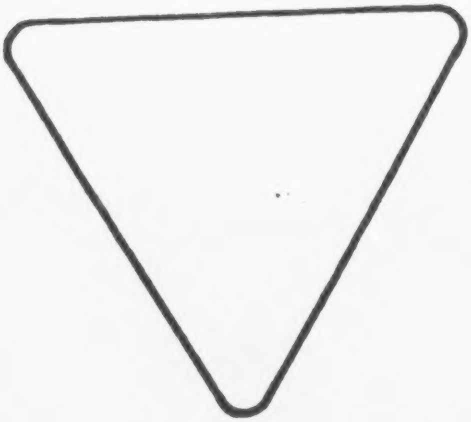


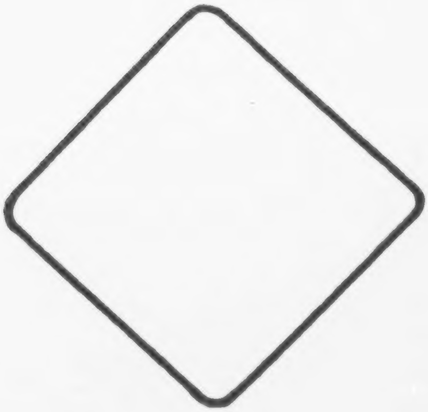
Worksheet C9

Regulatory signs: Name the sign according to the shape. On shapes with more than one sign, just choose one. *Can be used for E8: Color the sign appropriately and label according to the given shape.









Worksheet D3

Interstate Driving

I. Vocabulary

Directions: Match the vocabulary words with its definition by placing the letter of the definition in front of the vocabulary word.

1. ___ interstate
2. ___ controlled access
3. ___ interchange
4. ___ freeway
5. ___ rearview mirror
6. ___ blind spot
7. ___ prohibited
8. ___ right-hand lane
9. ___ left-hand lane
10. ___ expressway

A. An object on the vehicle that assists the driver with checking the traffic behind him

B. A fast, multiple lane, controlled access road a person may drive for long distances without interruptions

C. The location of the car when it cannot be seen in the rearview mirror of the car it is passing

D. The passing lane

E. The driving lane

F. Intersection of two highways at different levels with separate connecting roads for the transfer of traffic from one highway to another

G. Another term for interstate or expressway

H. When a car can enter or leave interstate highways only at certain locations where interchanges are built

I. Not allowed

J. Another term for freeway or interstate

Worksheet D3 Continued

II. Comprehension

Directions: Specify whether the statement is true or false by placing a "T" in front of the true statements and an 'F' in front of the false statements.

____1. A distinctive feature of an interstate is controlled access.

____2. An entrance ramp is a short two-way ramp that permit safe and easy entry.

____3. As you approach and enter the acceleration lane of an interstate, increase your speed.

____4. If you are traveling on a freeway you should never allow a car to enter---let him wait until you've gone by.

____5. If you miss your exit you should stop, and back up when all the cars have gone by you.

____6. Pass in the left-hand lane.

____7. Stop driving when you feel drowsy.

____8. Travel behind or go around the car if you are close to him. Stay out of his blind spot.

____9. The best place to stop and rest when traveling on an interstate is the shoulder.

____10. If you stop on the shoulder for an emergency you should raise the hood of the car.

Worksheet D3
ANSWER KEY

Refer to pages 19-20 of _Missouri Driver's Guide_.

I. _Vocabulary_

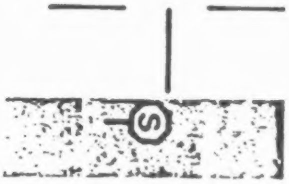
1. B
2. H
3. F
4. G
5. A
6. C
7. I
8. E
9. D
10. J

II. _Comprehension_

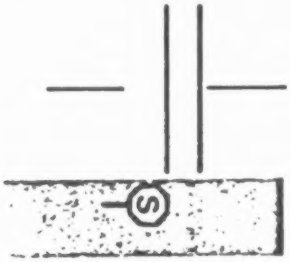
1. T
2. F
3. T
4. F
5. F
6. T
7. T
8. T
9. F
10. T

Worksheet D7

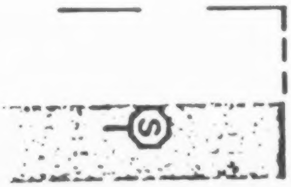
Stopping: Proper procedure for stopping at the line. Draw a car or rectangle (▭) to indicate where the vehicle is to stop at a line.
= stop sign



Stopping: Proper procedure for stopping at a crosswalk. Draw a car or rectangle ( ) to indicate where the vehicle is to stop at a crosswalk.

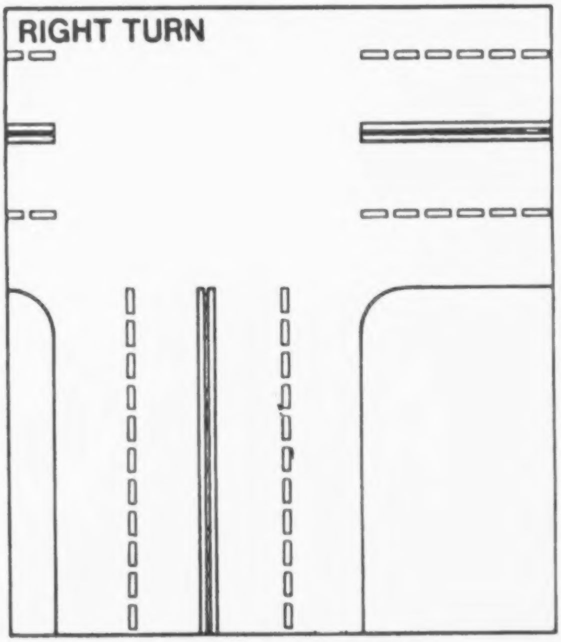


Stopping: Proper procedure for stopping at an intersecting road. Draw a car(s) or rectangle(s) to indicate where the vehicle is to stop at an intersecting road.

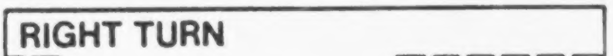


Worksheet D11

Proper turning movements: Turning right from a two-way street onto another two-way street.
Draw the vehicle and show by arrows the correct lanes to be turning into.

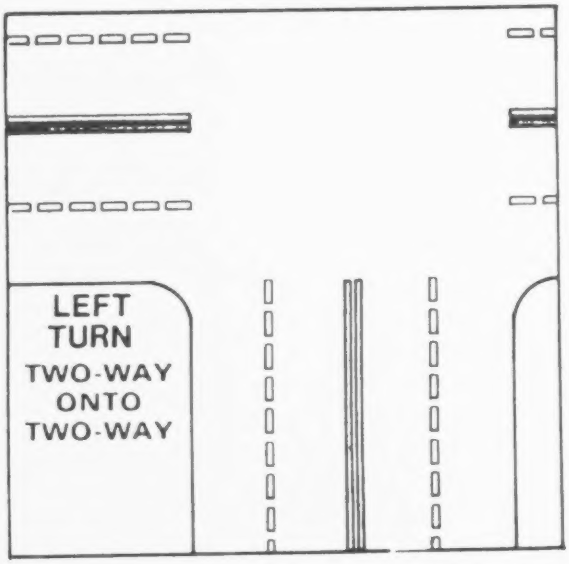


Proper turning movements: Turning right from a two-way street onto a one-way street.
Draw the vehicle and show by arrows the correct lanes to be turning into.

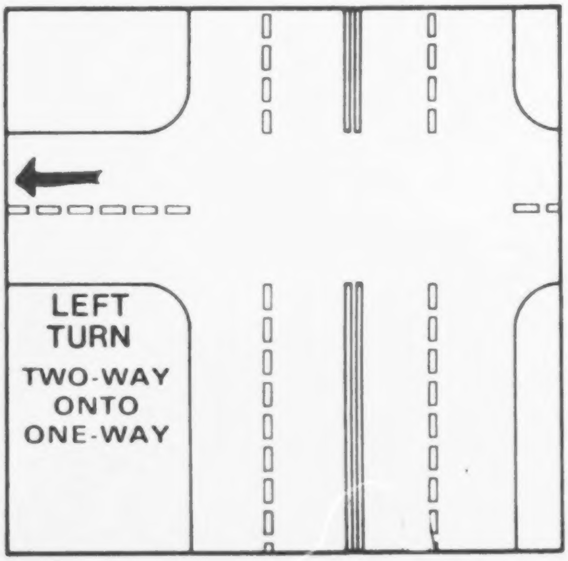


Worksheet D11a

Proper turning movements: Turning left from a two-way street onto another two-way street.
Draw a vehicle and show by arrows the correct lanes to be turning into.

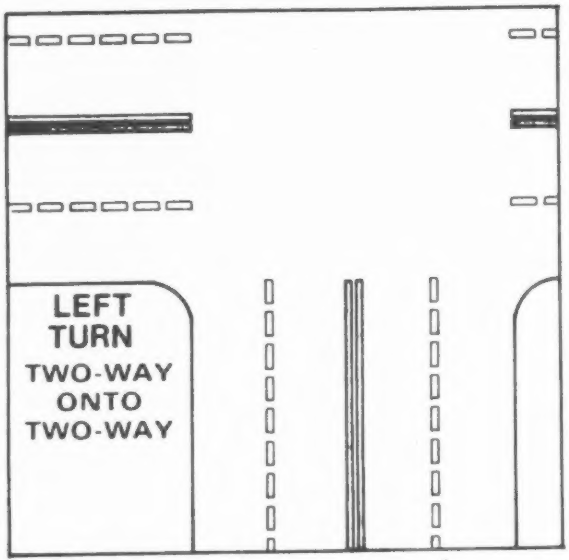

LEFT TURN
TWO-WAY ONTO TWO-WAY

Proper turning movements: Turning left from a two-way street onto a one-way street.
Draw a vehicle and show by arrows the correct lanes to be turning into.

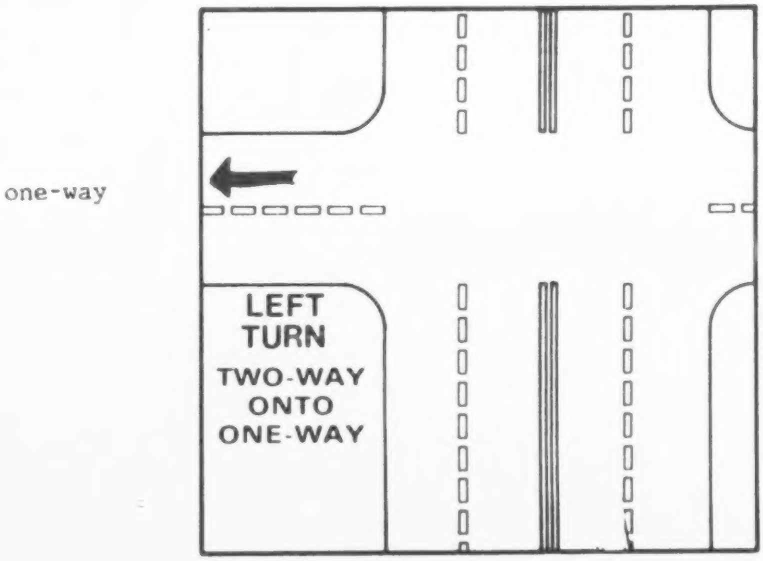

one-way
LEFT TURN
TWO-WAY ONTO ONE-WAY

Worksheet D12a

Proper turning movements: Turning left from a two-way street onto another two-way street.
Draw a vehicle and show by arrows the correct lanes to be turning into.


LEFT
TURN
TWO-WAY
ONTO
TWO-WAY

Proper turning movements: Turning left from a two-way street onto a one-way street.
Draw a vehicle and show by arrows the correct lanes to be turning into.


one-way
LEFT
TURN
TWO-WAY
ONTO
ONE-WAY

Worksheet E3

Rules of the Road

I. Vocabulary

Directions: Fill in the blanks with the appropriate vocabulary word listed below.

speed limit
miles per hour
reaction time
braking time
maximum
minimum
pedestrian
crosswalk
two-way street
municipalities
parallel parking
emergency vehicle
no-parking zone

1. It is unlawful to drive slower than the posted ______________ speeds.
2. Missouri State legislature enacted legislation setting the ________________ at 55 ____________________.
3. The speed limit is the fastest or the ________________ speed a vehicle should travel.
4. The time it takes a person to adjust or react to a situation is known as the ______________________.
5. A ________________ is one that is divided into two lanes with traffic moving in opposite directions.
6. When stopping at a corner be sure to stop behind the _____________.
7. ________________ may make rules of the road and traffic regulations to meet their needs and traffic conditions.
8. You must yield the right-of-way to a ________________ in a crosswalk.
9. You may be towed if you park in a _____________________.
10. An ______________________ may be an ambulance or firetruck.
11. The time it takes to stop a vehicle is the __________________.
12. When ________________ you stop even with the car ahead of the parking space.

Worksheet E3
ANSWER KEY

Refer to pages 19-29 of Missouri Driver's Guide.

I. Vocabulary

1. minimum
2. speed limit, miles per hour
3. maximum
4. reaction time
5. two-way street
6. crosswalk
7. municipalities
8. pedestrian
9. No parking zone
10. emergency vehicle
11. braking time
12. parallel parking

II. Comprehension

1. 5 of the following

a) When approaching an intersection, you must yield the right-of-way to vehicles which have already entered the intersection.

b) Yield the right-of-way to the car on the right, if two cars enter the intersection at the same time.

c) If you are entering a through street or highway, you should stop and proceed only when you can do so without interfering with other traffic.

d) You may turn right on a red light after you have made a complete stop, providing that you yield the right-of-way to pedestrians and other traffic proceeding as directed by the signal unless a "no right turn" sign is posted at the intersection.

e) When entering a freeway from an entrance ramp, you must yield the right-of-way to vehicles already in the freeway traffic.

f) You must yield the right-of-way to emergency vehicles, such as police cars, fire engines and ambulances, when they are displaying a red or blue light in front or when they signal with a siren. At such times, you should immediately drive to the right, and stop until the emergency vehicles have passed.

g) If you are in an intersection and intend to make a left turn, you must yield the right-of-way to any vehicle approaching from the opposite direction which is within the intersection or so close that an accident might occur as a result of your turning motion.

Worksheet E3
ANSWER SHEET (Continued)

h) If you are attempting to enter a public street or highway from a private drive or side road, you must yield the right-of-way to vehicles on the public street or highway.

i) You must yield the right-of-way to pedestrians in a marked crosswalk.

j) If you approach or overtake a school bus which is stopped on the highway to receive or discharge students, and whose driver has given the required signal to stop, you must stop before reaching the bus and not go on until the bus has resumed motion or you have been signaled by the driver to proceed. This law does not apply to vehicles approaching from the front on dual lane divided highways, or on four or more lane highways.

2. 5 of the following

*Within an intersection

*Within the pedestrian crosswalk

*Blocking access of fire hydrant

*On a bridge

*In a "No Parking" zone designated by official signs

*Along side a curb if it is painted yellow

*On the left side of the street, except on one-way streets

*So as to obstruct the normal flow of traffic or to create a hazard to other motorists.

3. Take your foot from the accelerator.
Turn the steering wheel into the direction of the skid.

Worksheet F3

The Point System

I. Vocabulary

Directions: Write a sentence for each of the following phrases. Refer to pages 36-37 of the Missouri Driver's Guide.

speeding
careless and imprudent
revocation
misrepresentation
intoxicated
narcotics
suspension

II. Comprehension

Directions: Match the appropriate statements by placing the letter of the second statement in the space provided. You may refer to the Missouri Driver's Guide pp. 36-37.

____ 1. System by the Department of Revenue will take away any person's driver license.

____ 2. You will be notified by the Department of Revenue if you have 4 pts. taken away in a ____________ month period.

____ 3. Your driver license will be suspended if 8 pts. are taken away in a _________ month period.

____ 4. The drivers first suspension will be for a period of ____________ days.

____ 5. For any moving violation of a state law or country or municipal ordinance ______ points will be assessed.

A. 30
B. 2
C. 6
D. 18
E. 1/3
F. privilege
G. The point system
H. 12
I. 4
J. 3

Worksheet F3 Continued

____ 6. For speeding in violation of a state law _______ points will be assessed.

____ 7. For careless and imprudent driving in violation of a state law _______ points will be assessed.

____ 8. For leaving the scene of an accident in violation of city or county ordinance ______ points will be assessed.

____ 9. For the first full year of driving without being convicted of a moving violation the point charged against your driver record will be reduced by _______.

____ 10. Driving in Missouri is not a right to all people but a _______________ to those who qualify.

Worksheet F3
ANSWER KEY

I. Vocabulary

Check for the appropriate use of vocabulary word in each sentence.

II. Comprehension

1. G
2. H
3. D
4. A
5. B
6. J
7. I
8. C
9. E
10. F

Worksheet G3

What to do When Involved in an Accident

I. Vocabulary

Directions: Fill in the blanks in each sentence with the appropriate vocabulary word.

authorized
accident

victim
law enforcement officer

1. Do not move the vehicle or leave the scene of the accident until a ____________ ____________ tells you to do so.
2. Try to make the ______________ person involved in the accident as comfortable as possible.
3. Call the ______________.
4. You should ______________ other traffic if the accident happened at night or in bad weather.
5. Exchange this information:

____

____

____

____

6. Do not ________________ the accident until the police officer tells you to do so.

II. Comprehension

Directions: Answer the following questions.

1. When are the occasions when you file an accident report?

a)

b)

c)

2. Describe what you would do if you were involved in an accident.

Worksheet G3
ANSWER KEY

Refer to page 30-32 of Missouri Driver's Guide.

I. Vocabulary

1. police officer
2. injured
3. police
4. warn
5. name, address, driver's license number, license plate number, name of insurance company, and insurance policy number
6. police officer

II. Comprehension

1. a. There was an uninsured motorist involved and a settlement has not been agreed to by all the parties involved within 60 days.

   b. There was property damage sustained in excess of $500.00 and/or personal injury or death resulted.

   c. The accident occurred upon a public street or highway of this state.

2. Refer to steps #1-6 on page 30 of Missouri Driver's Guide.

Worksheet H3

Alcohol and Driving

I. Vocabulary

Directions: Fill in the blanks with the appropriate words from the list below.

consent
breath test
imprisoned
conviction
blood alcohol content
fined

1. When a person appears to be driving while intoxicated he may be given a ____________________.

2. In such case the driver does not have to give his ________________.

3. When the breath test is given the __________________________ will be determined.

4. A person may be ______________ or _________________ if convicted of driving while intoxicated.

5. If a person receives a second ________________ he will be denied a drivers license.

II. Comprehension

Directions: Specify whether the statement if true or false by placing a "T" in front of the true statements and an "F" in front of the false statements.

____ 1. The breath test is to be administered by a law enforcement officer.

____ 2. You may be convicted of driving while intoxicated without administration of a chemical test.

____ 3. If a person under arrest refuses upon the request of the arresting officer to submit to a chemical test, then none shall be given.

____ 4. For a first conviction of driving while intoxicated you may be fined not less than $50.

____ 5. For a first conviction of driving while intoxicated you may be imprisoned up to 1 year.

____ 6. For a first conviction of driving while intoxicated your license will be revoked for one year.

____ 7. For the second conviction a driver's license will be revoked for 5 years.

____ 8. For a third conviction you may be sentenced to the state penitentiary.

____ 9. For a third conviction a driver's license will be revoked for 10 years.

Worksheet H3
ANSWER KEY

I. Vocabulary

1. breath test
2. consent
3. blood alcohol content
4. imprisoned or fined
5. conviction

II. Comprehension

1. T
2. T
3. T
4. F
5. F
6. T
7. T
8. T
9. T

Worksheet I3

Motor Vehicle Titling and Registration

I. Vocabulary

Directions: Write a sentence for each of the following phrases. Refer to pages 41-43 of the Missouri Driver's Guide.

Certificate of Title
application
odometer
manufacturer's Statement of Origin
penalty fee
lien
vehicle registration
license plate

II. Comprehension

Directions: Complete the following statements.

1. The documents required to title a new car purchased in Missouri are
2. The documents required to title a used vehicle purchased in Missouri are
3. The documents required to title a new vehicle purchased in another state are
4. The documents required to title a used vehicle purchased in another state are
5. What are the odometer reading requirements on a new or used car:

Worksheet I3 Continued

6. Where do you go to obtain a title in Missouri? ____________________
____

7. How many days do you have to obtain a title on a vehicle? __________
____

8. List the 3 requirements you must meet before you legally drive a vehicle in Missouri (p. 42 of Missouri Driver's Guide).

   a.

   b.

   c.

Worksheet 13
ANSWER KEY

I. Vocabulary

Check for the appropriate use of vocabulary words in each sentence.

II. Comprehension

1. obtain a title application and Manufacturer's Statement of Origin
2. obtain an assigned certificate of title from the previous owner
3. obtain a notarized bill of sale (with registered dealer number)
4. obtain a properly assigned certificate of title from the previous owner
5. odometer reading must be shown on the title or Manufacturer's Statement of Origin - it should appear above the notarized signature of the seller
6. Missouri Department of Revenue Branch or Agent License Office
7. 30
8. a. obtain a title

   b. register the vehicle

   c. obtain state license plates

Worksheet J3

Motor Vehicle Inspection and Equipment Regulations

I. Vocabulary

Directions: Fill in the blanks with the appropriate words from the list below.

inspection station
motorcycles
brakes
mufflers
safety glass
head lights
safety belts
windshield wipers
mechanical

1. Neither single beam nor multiple beam ____________________ should reflect a glare.
2. ________________________ reduces the likelihood of injury if the person's head hits the windshield in an accident.
3. Every vehicle must be equipped with two sets of _________________ which are in working condition at all times.
4. Not only are vehicles required to have an inspection but _______________________ must also be inspected.
5. Vehicles manufactured after June 30, 1964 are required to have 2 sets of _________________________ in the front seat.
6. To help clear your windshields in bad weather the vehicle needs to have ________________________________.
7. The inspection program encourages drivers to drive vehicles in good _____________________ condition.
8. Vehicles in Missouri shall be equipped with a properly attached exhaust system which includes ____________________________.
9. You may obtain an inspection at a certified ____________________.

II. Comprehension

Directions: Read the following statements. If the statement is true place a "T" in front of it and if it is false place an "F" in front of the statement.

____ 1. You must get a vehicle inspection every two years.

____ 2. Every motor vehicle, except motorcycles, must be equipped with two sets of brakes.

____ 3. A motor vehicle does not have a horn.

____ 4. In Missouri a motor vehicle must have rear license plate only.

____ 5. Towed vehicles must be within 15 feet of the towing vehicle.

____ 6. Passenger vehicles built today must all have seatbelts in the front and back seats.

____ 7. Taillights must be bright enough to be seen for 500 ft. by other drivers.

____ 8. All motor vehicles must have at least on taillight.

____ 9. A driver must dim headlights within 500 feet of an approaching vehicle.

____ 10. Studded snow tires may be used in Missouri from November 1 to April 1.

Worksheet J3
ANSWER KEY

Refer to pages 38-40 of the *Missouri Driver's Guide*.

I. Vocabulary

1. headlights
2. safety glass
3. brakes
4. motorcycles
5. safety belts
6. windshield wipers
7. mechanical
8. mufflers
9. inspection station

II. Comprehension

1. F
2. T
3. F
4. F
5. T
6. F
7. T
8. F
9. T
10. T

Worksheet K3

Additional Driving Tips -- Defensive Driving

I. Vocabulary

Directions: Write a sentence with each of the following vocabulary words.

defensive driver	accelerate
manual transmission	pavement
hydroplaning	carbon monoxide

II. Comprehension

Directions: Answer the following questions.

1. List 3 characteristics of defensive driving.

   a.

   b.

   c.

2. List 2 reasons to use safety belts.

   a.

   b.

   c.

3. List 4 ways to help ensure safe driving at night.

   a.

   b.

   c.

   d.

Worksheet K3 Continued

4. List two things to do if there is a fog when you are driving.

   a.

   b.

5. List 2 precautions to follow to reduce the possibility of hydroplaning.

   a.

   b.

Worksheet K3
ANSWER KEY

Refer to pages 55-63 of Missouri Driver's Guide.

I. Vocabulary

Read the sentences for the appropriate use of the vocabulary words.

II. Comprehension

1. a. Stay alert and keep eyes moving to keep track of what is happening at all times.
   b. Look for trouble spots.
   c. Have a plan of action if the other driver does the wrong thing.
   d. Know that the law requires drivers to protect each other from their own mistakes.
2. a. To keep from being thrown from the car.
   b. To keep from hitting the dashboard too hard.
   c. To keep in better control of the car.
3. Refer to list on p. 59 of Missouri Driver's Guide.
4. a. Reduce your speed.
   b. Be alert and be prepared for an emergency stop.
   c. Use your headlights but keep them dimmed.
5. a. Slow down during rainstorms.
   b. Slow down if road is standing in water.
   c. Replace tires when tread wear indicators are visible.
   d. Keep tires properly inflated.

Worksheet L4

Drivers License

Practice written examination for Missouri Operator's License

Circle the letter of the answer that best completes the statement. Write the letter on the line provided.

____ 1. The solid yellow stripe on Missouri highways mark the:
   a) passing zones
   b) no passing zones
   c) detour lines

____ 2. The broken yellow stripes on Missouri highways may be found:
   a) on 4-lane highways dividing the traffic going in the same direction
   b) on 2-lane highways where passing is permitted
   c) both

____ 3. When approaching a railroad crossing, you should
   a) slow down but keep on moving with the traffic
   b) slow down, look for a train and go
   c) slow down, look for a train, be prepared to stop

____ 4. The flashing red light means
   a) slow down
   b) yield
   c) stop

____ 5. On a traffic control signal, the _______ light is always located at the top.
   a) red
   b) yellow
   c) green

____ 6. Signals are to be used
   a) at all times
   b) when your blinkers no longer work
   c) when your taillight no longer works

____ 7. All signals should be given ________ feet ahead of the turning point.
   a) 50 feet
   b) 100 feet
   c) 200 feet

____ 8. One of the most common types of interchange is called:
   a) intersection
   b) cloverleaf
   c) triangle

____ 9. When entering a freeway on a ramp you should
a) stop before actual access onto the freeway
b) slow down to assure safe entrance
c) increase your speed to match the other vehicles in the thru lane

____ 10. When exiting a freeway
a) signal and get in to correct lane 50 feet before exiting
b) signal, get into the correct lane and exit without reducing speed until reaching deceleration lane
c) signal, get into correct lane, slow down in far right lane before exiting freeway

____ 11. The left lane of a freeway is for:
a) emergency vehicles only
b) speeding
c) passing

____ 12. The maximum freeway speed limit is:
a) 40 mph
b) 65 mph
c) 55 mph

____ 13. The proper procedure for stopping at a stop sign is:
a) at the crosswalk
b) before reaching an intersecting road
c) all of the above

____ 14. A driver should prepare for his turn at least ____ feet before he reaches an intersection.
a) 50 feet
b) 100 feet
c) 200 feet

____ 15. When turning left onto a one-way street from a two-way street, the movement shall be made from the lane nearest the center line or divider into:
a) the farthest left lane
b) either lane
c) farthest right lane

____ 16. Yield the right-of-way to the car on the ___ if two cars enter the intersection at the same time.
a) left
b) in-front
c) right

____ 17. You should not follow closer than ____ feet behind any emergency vehicles.
a) 100 feet
b) 300 feet
c) 500 feet

Worksheet L4 Continued

____ 18. When lights are required, you must have a white or amber light on the traffic side of the vehicle visible for _________ feet to the front and red light visible for __________ feet to the rear.
a) 300, 300
b) 300, 500
c) 500, 500

____ 19. To be able to stop or turn safe, keep at least __________.
a) 1 car length for every 5 miles per hour of speed
b) 1 car length for every 10 miles per hour of speed
c) 1 car length for every 20 miles per hour of speed

____ 20. A driver's license shall be suspended if you have:
a) 4 points in 12 months
b) 4 points in 18 months
c) 8 points in 18 months

Worksheet L4
ANSWER KEY

1. B
2. C
3. C
4. C
5. A
6. A
7. B
8. B
9. C
10. B
11. C
12. C
13. C
14. B
15. B
16. C
17. C
18. C
19. B
20. C

INSTRUCTIONAL MODULE

ACCESS SKILL: READ SCALES, DIALS, AND GAUGES

TASK ANALYSIS STEPS: A-D

VOCATIONAL AREA:
Auto Mechanics
Heating, Air Conditioning and Refrigeration
Machinist
Welding

ACTIVITY	MATERIALS/RESOURCES
TASK A: Student will be able to place numbers on a graph	
1. Give each student a piece of paper. Explain to the students you always begin with 0 (zero) and that each line will represent one number. Demonstrate by using a transparency. Place a zero next to a line in the middle of the page. Have students do the same. Moving upward, place a number, beginning with 1 and going through 10 next to each line. Have students do the same. Place a 0 (zero) in the middle of the page toward the bottom and number 1 through 10 to the right. Have students do the same.	Graph paper, pencils, transparency
2. Using colored pencils and the graph paper from Activity 1, direct the students to mark various lines.	Graph paper, colored pencils, Worksheet A2
3. Give the students a copy of a graph with the numbers missing. Have them place the correct numbers on the graph.	Worksheet A3, pencils
TASK B: Students will be able to read a set of scales	
1. Give the students practice in reading various numbers found on scales.	Worksheet B1
2. Have the students weight themselves on a set of bathroom scales and have them determine their weight.	Bathroom scales
TASK C: Student will be able to read various dials	
1. Have the students list objects or machines in a kitchen and in the industrial arts classroom that have dials on them.	
2. Give the students practice in reading numbers on dials.	Worksheet C3, C3a
3. Divide the students into groups of two. Give each group a set of colored pencils. Have one student in each group draw a dial and mark several numbers in different colors. The students read the numbers. After reading the numbers, have the students exchange places.	Colored pencils, paper
4. Visit the industrial arts classroom. Have students read the dials on various machines and equipment.	
TASK D: Student will be able to read various gauges	
1. Bring in a rain gauge. Fill it with various amounts of water and have students read the gauge.	Rain gauge
2. Divide the students into groups of two. Give each student a test tube which is marked like a rain gauge and a glass of water. One student fills the gauge and acts as the evaluator. The other student reads the gauge. Have the students exchange places.	Test tubes, glasses (paper cups), water

ACTIVITY	MATERIALS/RESOURCES
TASK D: CONTINUED	
3. Give the students practice in reading various numbers on gauges.	Worksheet D3
4. Mark various gauge numbers on 5 test tubes. Fill them with water and have students read the gauge.	Test tubes, water
5. Have the students visit the industrial arts classroom. The industrial arts teacher can point out and explain the gauges on various machines and equipment. Have the students read the gauges.	Industrial arts classroom

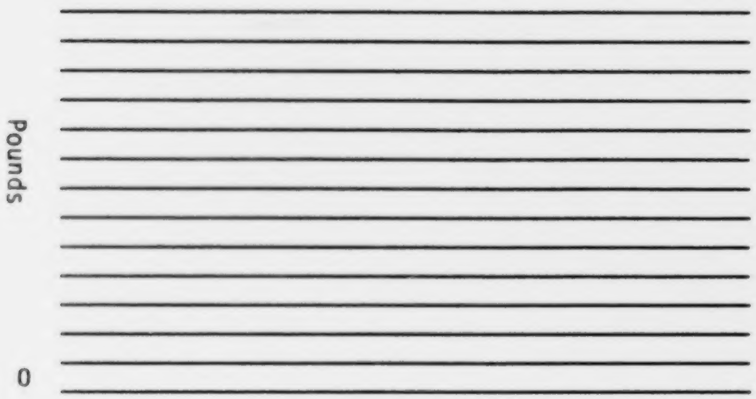
Worksheet A2

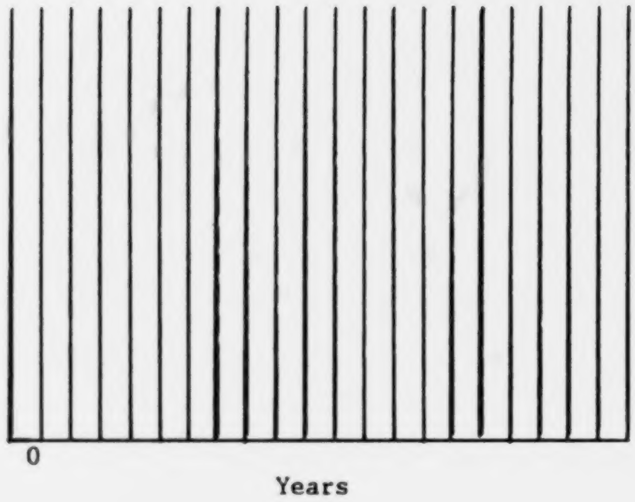
Follow these directions.

1. Using the horizontal numbers, place a red dot on the line representing 4.
2. Using the vertical numbers, place a blue dot on the line representing 7.
3. Using the horizontal numbers, place a black dot on the line representing 10.
4. Using the vertical numbers, place a yellow dot on the line representing 2.
5. Using the horizontal numbers, place a green dot on the line representing 6.
6. Using the vertical numbers, place an orange dot on the line representing 5.
7. Using the horizontal numbers, place a purple dot on the line representing 1.
8. Using the vertical numbers, place a red dot on the line representing 9.

Worksheet A3

Place numbers on the graphs.



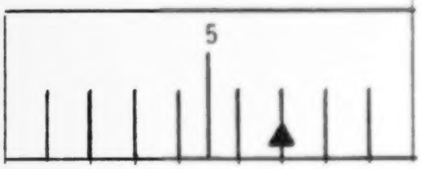


Worksheet B1

Reading Numbers on Scales

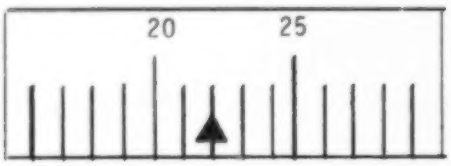
Determine the scale and then read the number.

1.



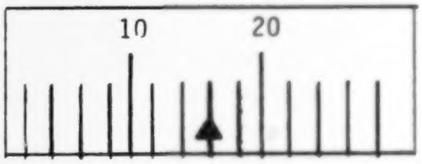
____

2.



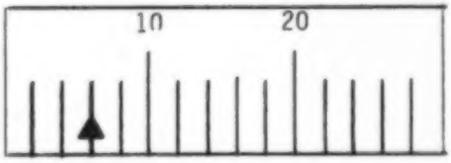
____

3.



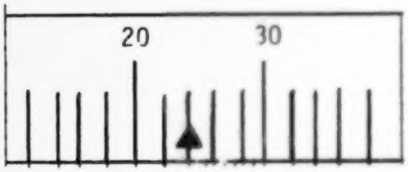
____

4.



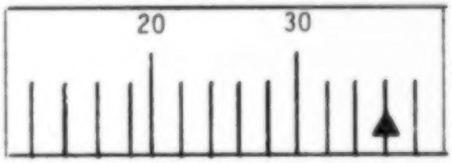
____

5.



____

6.



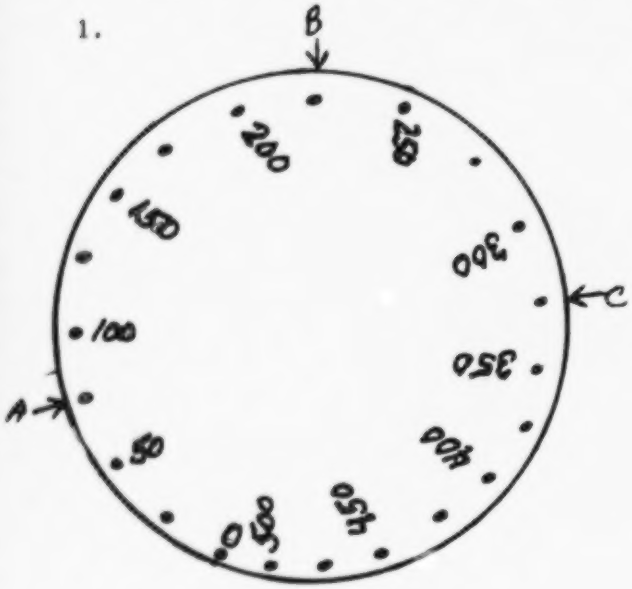
____

Worksheet C3

Reading Dials

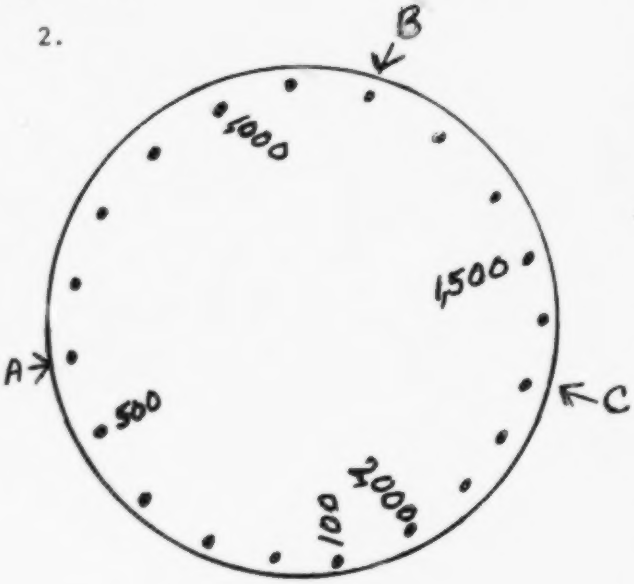
Determine the scale and read the following dials.

1.


B
200
250
150
300
C
100
350
A
50
400
0
500
450

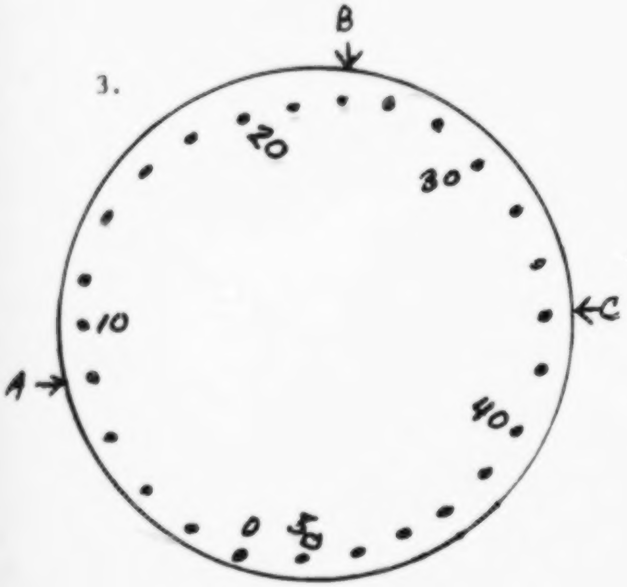
a. _____ b. _____ c. _____

2.


B
1000
1,500
C
A
500
2000
100

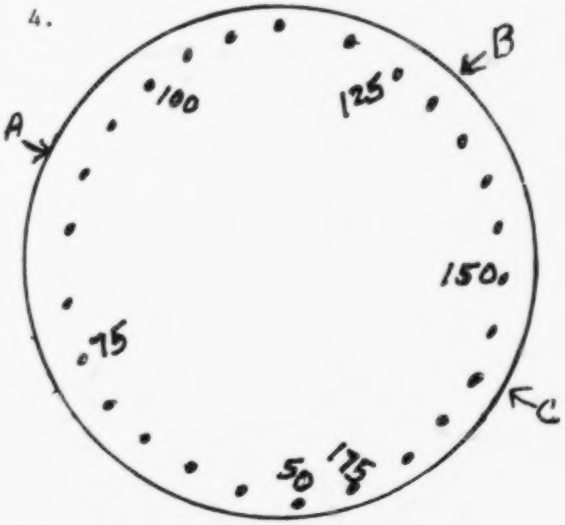
a. _____ b. _____ c. _____

3.


B
20
30
C
10
A
40
0
50

a. _____ b. _____ c. _____

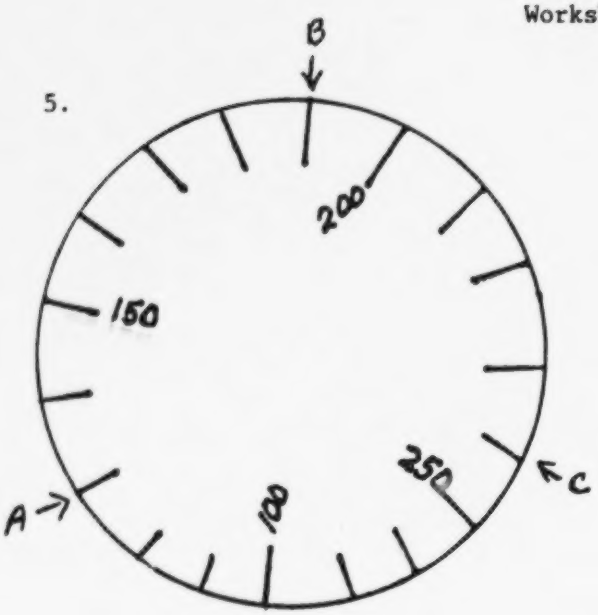
4.


B
100
125
A
150
75
C
50
175

a. _____ b. _____ c. _____

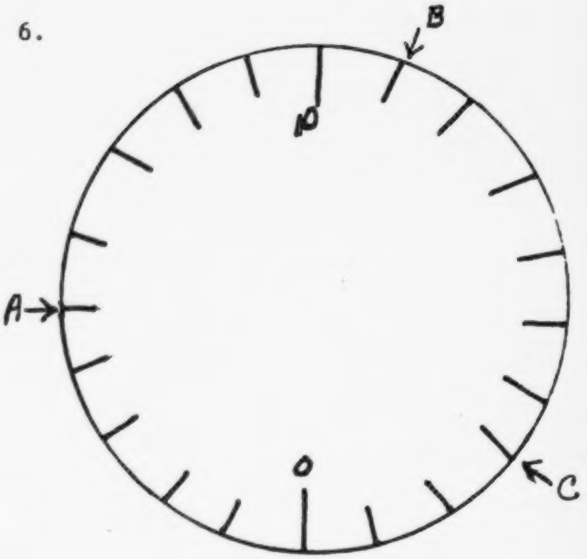
Worksheet C3a

5.


B
200
150
250
100
A
C

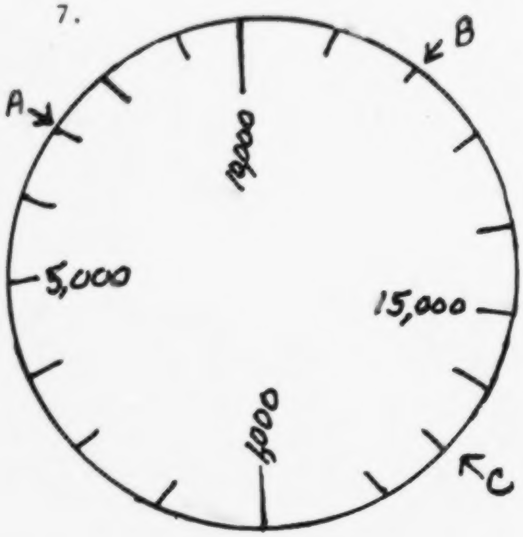
a. _____ b. _____ c. _____

6.



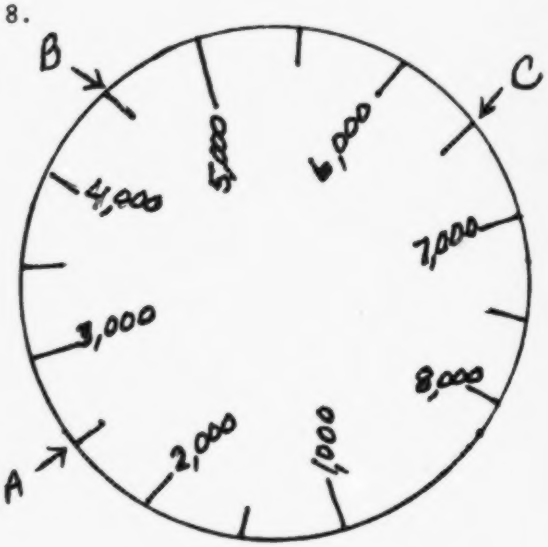
a. _____ b. _____ c. _____

7.


A
B
10,000
5,000
15,000
1000
C

a. _____ b. _____ c. _____

8.


B
C
5,000
6,000
4,000
7,000
3,000
8,000
2,000
1000
A

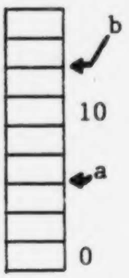
a. _____ b. _____ c. _____

Worksheet D3

Reading Gauges

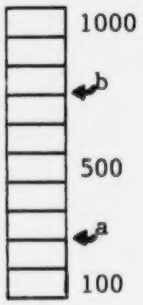
Determine the scale and read the following gauges.

1.



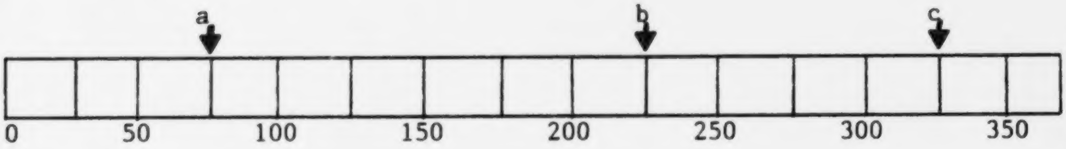
a. ______
b. ______

2.


1000
b
500
a
100

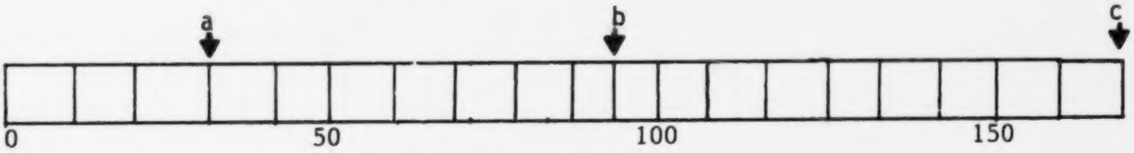
a. ______
b. ______

3.


a
b
c
0
50
100
150
200
250
300
350

a. ______ b. ______ c. ______

4.


a
b
c
0
50
100
150

a. ______ b. ______ c. ______